

**MODELLING THE DETERMINANTS OF
BEHAVIOURAL LIKELIHOOD TO ENGAGE IN
COMMUNITY-BASED SURVEILLANCE OF
INFECTIOUS DISEASES AMONG COMMUNITY
REPRESENTATIVES IN KELANTAN, MALAYSIA**

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UNIVERSITI SAINS MALAYSIA

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by

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**Thesis submitted in fulfilment of the requirements
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LIST OF SYMBOLS

a	Constant (for Regression Formula)
α	Significance Level / Probability of a Type I Error
β	Probability of Type II Error / Regression Coefficient
b	Regression Coefficient
δ	Difference between Parameter
df	Degree of Freedom
e	Value of Error
λ	Factor Loading
n	Number of Participants / Frequency
N	Number of Items
p	p-value / Constant (for Sample Size Calculation)
r	Correlation Coefficient
Σ	Summation of All Values
χ^2	Chi-square
θ_{ij}	Covariance between error terms of items i and j
$\rightarrow$	direct path or causal relationship between the two variables

LIST OF ABBREVIATIONS

2-PL IRT	Two-Parameter Logistic Item Response Theory
AMR	Antimicrobial Resistance
APSED	Asia Pacific Strategy for Emerging Diseases
ATT	(Negative) Attitudes
AVE	Average Variance Extracted
BARR	Perceived Barriers
BEN	Perceived Benefit
BL	Behavioural Likelihood to engage in CBS
CBS	Community-Based Surveillance
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CI	Confidence Interval
CHVs	Community Health Volunteers
CHWs	Community Health Workers
CPRC	National Crisis Preparedness and Response Centre
CR	Composite Reliability
CVD	Cardiovascular Disease
CVI	Content Validity Index
EBS	Event-Based Surveillance
EFA	Exploratory Factor Analysis
EVD	Ebola Virus Disease
FVI	Face Validity Index
GBD	Global Burden of Disease
GFI	Goodness of Fit Indices
GRAM	Global Research on Antimicrobial Resistance
HBM	Health Belief Model
HPM	Health Promotion Model
HUSM	Hospital Universiti Sains Malaysia
I-CVI	Item-level Content Validity Index
IBS	Indicator-Based Surveillance
IDSR	Integrated Disease Surveillance and Response
IFI	Incremental Fit Index

IFRC	International Federation of Red Cross and Red Crescent Societies
IHR	International Health Regulations
INT	Intention to participate in CBS
IRT	Item Response Theory
JPEPM	Human Research Ethics Committee of Universiti Sains Malaysia
KAP	Knowledge, Attitudes, and Practices
KAP-CBS-ID	Knowledge, Attitudes, and Perceptions regarding Community-Based Surveillance of Infectious Diseases questionnaire
KID1	Knowledge of Infectious Diseases (Factor 1)
KID2	Knowledge of CBS (Factor 2)
KID3	Knowledge of Community-Level Case Definition (Factor 3)
KMO	Kaiser-Meyer-Olkin (Measure of Sampling Adequacy)
MAR	Missing at Random
MCAR	Missing Completely at Random
MERS-CoV	Middle East Respiratory Syndrome Coronavirus
MI	Modification Index
ML	Maximum Likelihood
MLM	Maximum Likelihood Mean Adjusted
MLR	Robust Maximum Likelihood
MNAR	Missing Not at Random
MOH	Ministry of Health (Malaysia)
MySED	Malaysia Strategy for Emerging Diseases and Public Health Emergencies
NNFI	Non-Normed Fit Indices
PBC	Perceived Behavioural Control
PCA	Principal Component Analysis
PD	Positive Definite
PHEIC	Public Health Emergency of International Concern
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
SATs	Scholastic Aptitude Tests
S-CVI	Scale-level Content Validity Index
SD	Standard Deviation
SE	Standard Error; Self-Efficacy
SEM	Structural Equation Modeling
SN	Subjective Norms

SPSS	Statistical Product and Service Solutions
SRMR	Standardized Root Mean Square Residual
SUS	Perceived Susceptibility
TB	Tuberculosis
TLI	Tucker-Lewis Index
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
USM	Universiti Sains Malaysia
VIF	Variance Inflation Factor
WHO	World Health Organization
WLSMV	Weighted Least Squares Mean and Variance Adjusted
WRMR	Weighted Root-Mean-Square Residual

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**PEMODELAN PENENTU KEMUNGKINAN TINGKAH LAKU UNTUK
MELIBATKAN DIRI DALAM PEMANTAUAN BERASASKAN KOMUNITI
BAGI PENYAKIT BERJANGKIT DALAM KALANGAN WAKIL
KOMUNITI DI KELANTAN, MALAYSIA**

ABSTRAK

Pengawasan berasaskan komuniti (CBS) adalah strategi untuk pengesanan awal penyakit berjangkit yang melibatkan anggota komuniti mengesan dan melaporkan perubahan corak kesihatan kepada pihak berkuasa kesihatan, memudahkan pengawalan penyakit sebelum wabak meluas. Walaubagaimanapun, penyertaan komuniti dalam CBS masih terhad, dan faktor-faktor yang mempengaruhi penglibatan masih kurang dikaji. Tiada alat pengukuran yang sah untuk menilai faktor-faktor ini. Kajian ini bertujuan membangunkan dan mengesahkan soal selidik Pengetahuan, Sikap, dan Persepsi dalam bahasa Melayu, berasaskan Teori Tindakan Beralasan (TRA) dan Model Kepercayaan Kesihatan (HBM), bagi mengenal pasti faktor penentu penyertaan komuniti dalam CBS. Kajian ini dijalankan dalam tiga fasa menggunakan reka bentuk keratan rentas. Fasa I membangunkan soal selidik (KAP-CBS-ID) dalam bahasa Melayu yang mengandungi tiga bahagian: pengetahuan, sikap, dan persepsi, masing-masing dengan tiga domain. Bahagian pengetahuan merangkumi pengetahuan tentang penyakit berjangkit, CBS, dan definisi kes komuniti; bahagian sikap merangkumi norma subjektif, niat menyertai, dan kemungkinan tingkah laku; bahagian persepsi meliputi persepsi kerentanan, faedah, dan kecekapan sendiri. Pengesahan kandungan dilakukan oleh pakar kesihatan awam dan epidemiologi, manakala pengesahan muka dan praujian dilakukan dengan wakil komuniti. Fasa II menguji soal selidik pada 152 peserta menggunakan Teori Respons Item 2-Parameter

Logistik (2-PL IRT) untuk bahagian pengetahuan, serta Analisis Faktor Eksploratori (EFA) untuk sikap dan persepsi. Analisis 2-PL IRT mengekalkan 31 daripada 45 item. EFA mengesahkan struktur multidimensi dan mendedahkan faktor tambahan: sikap negatif dan halangan yang dirasakan. Analisis kebolehpercayaan menunjukkan konsistensi dalaman yang baik (Cronbach's alpha: 0.71–0.91), dengan bahagian sikap dan persepsi masing-masing menerangkan 50.8% dan 58.7% varians. Fasa III melibatkan Analisis Faktor Pengesahan (CFA) dan Pemodelan Persamaan Berstruktur (SEM) dengan 470 peserta. CFA menyokong model pengukuran dengan indeks kesesuaian yang memuaskan. SEM menggabungkan komponen TRA dan HBM, menunjukkan hubungan positif signifikan antara pengetahuan penyakit berjangkit, norma subjektif, dan niat menyertai, manakala sikap negatif mempunyai hubungan berkadar songsang. Kemungkinan tingkah laku dipengaruhi positif oleh niat, persepsi kerentanan, dan faedah, tetapi negatif oleh halangan yang dirasakan. Kecekapan sendiri mempunyai pengaruh kuat terhadap faedah dan kerentanan yang dirasakan. Model menerangkan 46.1% varians kemungkinan tingkah laku, 57.0% varians niat, 70.4% varians persepsi kerentanan, dan 61.7% varians persepsi faedah. Kajian ini berjaya membangunkan dan mengesahkan soal selidik KAP-CBS-ID bahasa Melayu dengan kebolehpercayaan dan kesahan yang baik. Penemuan utama menekankan kepentingan menangani jurang pengetahuan, memupuk sikap positif, dan mengurangkan halangan bagi meningkatkan penyertaan komuniti dalam CBS. Alat ini menyediakan asas untuk penyelidikan dan intervensi masa depan bagi mengukuhkan sistem CBS, meningkatkan pengesanan awal penyakit dan kawalan wabak.

**MODELLING THE DETERMINANTS OF BEHAVIOURAL
LIKELIHOOD TO ENGAGE IN COMMUNITY-BASED SURVEILLANCE
OF INFECTIOUS DISEASES AMONG COMMUNITY REPRESENTATIVES
IN KELANTAN, MALAYSIA**

ABSTRACT

Community-based surveillance (CBS) is relatively new strategy for early detection of infectious disease. It involves community members actively participate in detecting and reporting changes in health patterns within their communities to health authorities, facilitating disease containment before outbreaks become widespread and difficult to control. However, community participation in CBS remains limited, and factors influencing engagement, such as knowledge, attitudes, and perceptions, are understudied. Additionally, no validated measurement tool exists to assess these factors. This study aimed to develop and validate a Malay language Knowledge, Attitudes, and Perception's questionnaire, grounded in the Theory of Reasoned Action and the Health Belief Model, to identify determinants of community participation in CBS. The study was conducted in three phases using a cross-sectional design. In Phase I, a questionnaire (KAP-CBS-ID) was developed and translated to Malay. It comprised three main sections—knowledge, attitude, and perception—each with three domains. The knowledge section covered knowledge about infectious diseases, CBS, and community-level case definition; the attitude section initially addressed subjective norms, intention to participate, and behavioural likelihood; and the perception section included perceived susceptibility, perceived benefits, and self-efficacy. Content validation was performed by public health and epidemiology experts, and face validation and pretesting were conducted with community representatives. In Phase II, the questionnaire was tested with 152 participants using 2-parameter logistic Item

Response Theory (2-PL IRT) for knowledge section, and Exploratory Factor Analysis (EFA) for attitude and perceptions. The 2-PL IRT of for knowledge retained 31 of 45 items after removing poorly performing ones. The EFA confirmed a multidimensional structure for attitudes and perceptions, revealing additional factors: negative attitudes and perceived barriers under attitude and perception respectively. Reliability analysis showed good internal consistency (Cronbach's alpha: 0.71–0.91), with the attitude and perception sections explaining 50.8% and 58.7% of the variance, respectively. Phase III involved Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) with 470 participants. CFA supported the measurement models with satisfactory fit indices. The SEM, integrating components of TRA and HBM. SEM analysis revealed significant positive associations between knowledge of infectious diseases, subjective norms, and intention to participate, while negative attitudes had an inverse relationship. Behavioural likelihood was positively influenced by intention, perceived susceptibility, and benefits but negatively affected by perceived barriers. Self-efficacy strongly influenced perceived benefits and susceptibility. The model explained 46.1% of behavioural likelihood variance, 57.0% of intention, 70.4% of perceived susceptibility, and 61.7% of perceived benefits. In conclusion, the study successfully developed and validated the Malay KAP-CBS-ID questionnaire, demonstrating good reliability and validity. Key findings highlighted the importance of addressing knowledge gaps, fostering positive attitudes, and reducing barriers to enhance community participation in CBS. This tool provides a foundation for future research and interventions to strengthen CBS systems, improving early disease detection and outbreak control.

CHAPTER 1

INTRODUCTION

1.1 Background

The World Health Organization (WHO) defines Community-Based Surveillance (CBS) as "the systematic detection and reporting of events of public health significance within a community, by community members" (Guerra, Bayugo, et al., 2019a). CBS Initially designed for the early detection and reporting of infectious diseases, and has also evolved into a flexible tool capable of identifying a wide range of public health events, including monitoring births, deaths, and verbal autopsies (Kumar et al., 2012; Moshabela et al., 2015)

The conventional surveillance systems often fail to detect outbreaks in their early stages, as health authorities typically rely on formal healthcare channels (IFRC, 2017). CBS emerges as a solution to this challenge, it is particularly significant in addressing the limitations of traditional surveillance systems, which often detect outbreaks in their late phases. Outbreaks often begin with clusters of unwell individuals or sudden deaths in a community that could go undetected by traditional surveillance systems. Although community members may recognise the threat early, health authorities frequently receive this information too late to contain disease spread effectively (IFRC, 2024c). CBS addresses this gap by enabling community members to actively monitor and report unusual health events to health authorities or local representatives, such as village leaders, religious leaders, teachers, or any community representatives (WHO, 2015a).

CBS complements the existing surveillance systems, especially in areas with limited or non-existent surveillance systems, and is increasingly recognised as a promising approach in global health security (IFRC, 2017; Worsley-Tonks et al.,

2022). Traditional facility-based surveillance depends on healthcare-seeking behaviours, which can be hindered by barriers like limited healthcare access, transportation challenges, or distrust in formal health systems (McGowan et al., 2022). These factors often delay health facility interventions, complicating disease containment and increasing the risk of transmission. To mitigate these issues, CBS engages community members in proactive disease surveillance, bridging gaps in healthcare access and strengthening early response capabilities.

Community involvement in disease surveillance was emphasised in the 2001 Integrated Disease Surveillance and Response (IDSR) technical guidelines for the African region, which advocated for community participation in detecting and responding to public health problems (Kaboré et al., 2001). The 2010 edition introduced the term "community-based surveillance" and defined it as the process by which trained surveillance informants identify and report significant events (WHO, 2010c). Subsequently, the WHO and the International Federation of Red Cross and Red Crescent Societies (IFRC) released guidelines in 2014, 2015, and 2017 to standardize and operationalise CBS systems globally (IFRC, 2017; WHO, 2014; WHO, 2015b).

In Malaysia, the growing burden of communicable and non-communicable diseases underscores the urgent need for robust surveillance systems. The rise in diseases such as dengue, tuberculosis, HIV/AIDS, and vaccine-preventable illnesses like measles and diphtheria is further exacerbated by the threats posed by emerging and re-emerging infectious diseases, as well as challenges associated with a large immigrant population which also increases the risk of imported infections (Ministry of Health Malaysia, 2020). These diseases remain significant contributors to hospitalisations and deaths in Malaysia, accounting for 6.8% of hospitalisations and

13.02% of deaths in Ministry of Health hospitals in 2020, with similar trends observed in private hospitals (Ministry of Health Malaysia, 2021). Such conditions can be greatly reduced through early intervention, making CBS essential for facilitating timely reporting and enabling early disease control through active community participation.

Any event of public health importance in Malaysia, such as disease outbreaks or public health emergencies, must be promptly reported to health authorities through appropriate channels, either formal, such as the traditional established surveillance system, or informal, such as community members. However, there have been many instances of delays in reporting these health events to health facilities and, consequently, to the Ministry of Health. Often, such events were reported much earlier within the community or by the media, without the knowledge of Ministry officials (Ministry of Health Malaysia, 2018). This highlights a significant gap in awareness and understanding of CBS systems within the community, as well as limited participation in CBS practices, both of which are vital for the timely identification and management of public health threats. Without adequate knowledge of the importance and mechanisms of CBS, communities may fail to recognize their role in disease surveillance or the value of their contributions in preventing disease outbreaks (McGowan et al., 2022). Such limited engagement can delay public health responses, potentially allowing outbreaks to escalate before health authorities are alerted. Therefore, strengthening community awareness and fostering proactive participation in CBS are critical to enhancing the effectiveness of public health surveillance systems.

Given the limited research on community knowledge, attitudes, and perceptions toward CBS, this study aims to develop and validate a Malay-language

questionnaire to assess knowledge, attitudes, and perceptions regarding community-based surveillance of infectious diseases (KAP-CBS-ID questionnaire) among community representatives in Kelantan, and determine the structural relationships between the factors that could enhance community participation in CBS of infectious diseases. The questionnaire seeks to investigate factors influencing community participation in CBS, including knowledge and other factors related to attitudes and perceptions of specific health behaviours. To achieve this, theoretical frameworks such as the Theory of Reasoned Action (TRA) and the Health Belief Model (HBM) were integrated. These frameworks guided the examination of attitudes and subjective norms (from TRA), as well as perceived benefits, perceived barriers, perceived susceptibility, and self-efficacy (from HBM), along with knowledge factors. These constructs were explored for their potential impact on individuals' intentions to participate in CBS and their likelihood of active community involvement in surveillance activities (Green et al., 2021; LaCaille, 2020).

To provide clarity on the theoretical constructs examined in this study, the questionnaire integrates components from both the Theory of Reasoned Action (TRA) and the Health Belief Model (HBM). Based on TRA, attitude constructs include attitudes toward CBS (positive and negative attitudes toward the behavior) and subjective norms (perceived social pressure to perform the behavior), which influence behavioral intention (intention to participate in CBS of infectious diseases). The HBM contributes perception constructs including perceived susceptibility (perceived risk of infectious disease outbreaks), perceived benefits (anticipated positive outcomes of CBS participation), perceived barriers (anticipated obstacles to CBS participation), and self-efficacy (confidence in one's ability to perform CBS of infectious diseases). These theoretical constructs collectively influence behavioral likelihood (the

probability of actually engaging in CBS of infectious diseases), which serves as the ultimate outcome variable representing actual participation behaviour.

1.2 Problem Statement

Infectious diseases pose a significant threat to public health and the economic stability of societies globally (Drotman et al., 2024). For many centuries, these diseases have been among the leading causes of death and disability, and continually challenging health security and human progress (Colzani, 2019). The emergence of infectious diseases such as MERS, Zika, and SARS underscores the persistent global threat posed by newly emerged and re-emerging pathogens (Chan et al., 2022). Early detection systems are essential, as these outbreaks often originate within local communities and remain undetected by conventional surveillance systems until they escalate and spread widely. This problem equally affecting all countries, and it is particularly significant in Malaysia, where infectious diseases such as dengue, tuberculosis (TB), HIV, Malaria, and leptospirosis pose significant public health risks (Ministry of Health Malaysia, 2021, 2022), along with lack of population awareness of CBS. The country also grapples with the ongoing threat of COVID-19, along with other diseases such as hepatitis B and C. These diseases, along with food and waterborne illnesses like food poisoning and typhoid, and vector-borne diseases like chikungunya, highlight the urgent need for a sensitive and efficient early warning system (Ministry of Health Malaysia, 2022). Such a system is important for detecting potential public health risks before they develop into large epidemics. Countries equipped with robust early warning and response mechanisms can identify emerging health threats at their onset, enabling timely and effective interventions (Ministry of

Health Malaysia, 2018). This, in turn, helps to control the spread of diseases and reduce human and economic losses (Balajee et al., 2021).

However, community engagement in CBS is still a challenge (Eastman et al., 2024; Lee et al., 2023; McGowan et al., 2022), and delays in disease reporting remain a significant issue in Malaysia, this consequently delays timely interventions and containment efforts. The Malaysian Event-Based Surveillance (EBS) protocol issued in 2018 highlighted persistent delays in reporting public health events to senior Ministry of Health officials (Ministry of Health Malaysia, 2018). An administrative directive issued that year by the Deputy Director-General of Public Health noted that health events were often reported by media or within communities much before they reached Ministry officials. A similar directive in 2006 had already stressed the urgency of timely reporting through formal and informal channels, including community sources (Ministry of Health Malaysia, 2018).

The importance of involving communities in public health event reporting was further emphasized in the WHO's 2020 Joint External Evaluation of Malaysia's International Health Regulations (IHR) core capacities. The report identified barriers to strengthening community involvement in CBS, such as limited access to reporting mechanisms and challenges in sustaining volunteer participation (WHO, 2020).

A lack of understanding among community members about CBS of infectious diseases can prevent them from participating in efforts to detect and report health issues. Similarly, having insufficient knowledge, poor attitudes, or perceptions about CBS leads to poor involvement in surveillance activities as part of healthy behaviour (Glanz et al., 2015). This may also result in limited awareness of their roles, responsibilities, and the significance of their contributions to CBS (Halton et al., 2013; Samsudin et al., 2024).

Although community awareness and engagement are crucial for the timely detection and reporting of infectious diseases, there is still a significant research gap regarding communities' knowledge, attitudes, and perceptions about infectious disease reporting and the factors influencing their active participation in CBS. Specifically, there is a lack of validated instruments to measure these behavioral determinants in the Malaysian context, with limited published research on community-based surveillance participation among Malaysian communities. This lack of understanding of drivers of community engagement in CBS, coupled with the absence of validated tools to assess these factors, could complicate the efforts to reduce the health impacts of infectious diseases at the community level (Mohammad et al., 2020).

1.3 Rationale of the Study

The consequences of underreporting of early signs of outbreaks are a serious concern. It can severely impact the health system, leading to increased morbidity and mortality as well as significant economic losses (Colzani, 2019). Early containment of outbreaks is crucial to mitigate these negative effects. CBS offers a promising solution facilitating timely detection and reporting of health events, but its success largely depends on public awareness and active community participation (Guerra, Acharya, et al., 2019a; IFRC, 2021a; McGowan et al., 2022; WHO, 2015a). Despite its importance, there is a notable lack of research on CBS, particularly in highlighting community knowledge, attitudes, and perceptions, underscoring the need for a robust tool to assess these factors.

Given the delays in reporting health events in Malaysia, and its usually reported within the community before the health authorities (Ministry of Health Malaysia, 2018), Identifying factors that influence individuals' intentions and likelihood to

engage in CBS of infectious diseases, such as reporting health events through appropriate channels, is essential for addressing this gap.

Community representatives serve as crucial intermediaries between the general population and formal health systems, making them an ideal study population for understanding CBS dynamics (Sabo et al., 2023). These individuals, including village heads, community leaders, religious leaders, teachers, and local health volunteers, possess unique characteristics that make them particularly relevant for CBS research. They typically have large social networks within their communities, established trust among residents, and often serve as first points of contact when health concerns arise (Charles & Fievre, 2021). Community representative's perceptions, knowledge gaps, and behavioral intentions toward CBS activities can significantly impact the effectiveness of surveillance efforts, as they often guide community responses to health threats and facilitate communication between the community and health authorities. Furthermore, community representatives are frequently targeted by public health programs as key stakeholders for implementing CBS initiatives (WHO, 2021a), making their understanding and acceptance of CBS critical for program success.

This study seeks to address these needs by developing a comprehensive questionnaire to assess knowledge about infectious diseases and CBS. Additionally, the study incorporates behavioural theories, including the Theory of Reasoned Action (TRA) and the Health Belief Model (HBM), to examine how attitudes, subjective norms, perceived benefits, perceived barriers, perceived susceptibility, and self-efficacy shape intentions and behavioural likelihood to participate in CBS (Green et al., 2021; LaCaille, 2020).

This effort highlights targetable factors to increase community participation, ultimately reducing the impact of communicable diseases and other public health

events through enhanced community involvement in CBS. The findings from this study are expected to provide valuable insights into the factors influencing community participation in CBS. These insights will inform public health strategies and policies, enabling the design of effective interventions to enhance public involvement in CBS. By improving community participation, this study aims to facilitate the early identification and reporting of health threats, ultimately strengthening public health systems and mitigating the impact of infectious disease outbreaks.

1.4 Scope of the Study

This study focuses on the knowledge, attitudes, and perceptions of community leaders toward CBS of infectious diseases, specifically in Kelantan state, Malaysia. Kelantan was chosen as the study site not only due to the researcher's affiliation with USM, located in the state, which facilitates access to local communities, but also because of its diverse population comprising both urban and rural communities. This diversity enhances the generalizability of the study findings, making them applicable to a broader range of settings. The study started with a questionnaire development to assess these issues, followed by examining factors such as knowledge of infectious diseases, attitudes toward CBS, subjective norms, perceived benefits and barriers, self-efficacy, and intention to participate in CBS of infectious diseases, and the influence of these factor on behavioural likelihood to participate in CBS. The study population consists of school teachers and religious teachers as community representatives (DHRRA Malaysia, 2022) in Kelantan.

1.5 Research Questions

Phase I

1. Is the newly developed Malay version questionnaire for assessing the knowledge, attitudes, and perceptions of Malaysian community representatives towards community-based surveillance of infectious diseases (KAP-CBS-ID) valid and reliable?
2. Does the Malay version of the questionnaire demonstrate validity through content validity (CVI) and face validity (FVI)?

Phase II

3. Does the Malay version of the questionnaire demonstrate validity through exploratory factor analysis (EFA) and Item Response Theory (IRT)?
4. Does the Malay version of the questionnaire demonstrate internal reliability through Cronbach's Alpha?

Phase III

5. Does the Malay version of the questionnaire demonstrate validity through confirmatory factor analysis (CFA)?
6. Does the Malay version of the questionnaire demonstrate reliability through Raykov's construct reliability?
7. Is there a significant path relationship between knowledge constructs (knowledge of infectious diseases, knowledge of CBS, and community-level case definition), attitude constructs based on TRA (negative attitudes toward CBS, subjective norms, intention to participate in CBS, and behavioural likelihood to engage in CBS of infectious diseases), perception constructs based on HBM (perceived benefits, barriers, susceptibility, and self-efficacy),

and their influence on behavioural likelihood to engage in CBS of infectious diseases among community representatives in Kelantan?

1.6 Research Objectives

1.6.1 General Objective

This study aims to develop and validate a Malay version questionnaire to assess KAP-CBS-ID among community representatives in Kelantan, and determine the structural relationships between the factors that could enhance community participation in CBS of infectious diseases.

1.6.2 Specific Objectives

Phase I

1. To develop a new Malay language questionnaire assessing KAP-CBS-ID.
2. To assess the CVI and FVI of the Malay version of the questionnaire

Phase II

3. To examine the validity of the Malay version of the KAP-CBS-ID questionnaire using EFA and IRT.
4. To examine the internal consistency reliability of the KAP-CBS-ID Malay version of the questionnaire through Cronbach's Alpha.

Phase III

5. To evaluate the validity of the Malay version of the KAP-CBS-ID questionnaire using CFA.
6. To assess the reliability of the Malay version of the KAP-CBS-ID questionnaire using Raykov's construct reliability.
7. To examine the path relationship between knowledge constructs (knowledge of infectious diseases, knowledge of CBS, and community-level case definition), attitude constructs based on TRA (negative attitudes toward CBS, subjective norms, intention to participate in CBS, and behavioural likelihood to engage in CBS of infectious diseases), perception constructs based on HBM

(perceived benefits, barriers, susceptibility, and self-efficacy), and their collective influence on behavioural likelihood to engage in CBS of infectious diseases among community representatives in Kelantan.

1.7 Research Hypotheses

1. The newly developed Malay-language questionnaire demonstrates satisfactory content and face validity, as assessed through CVI and FVI.
2. The EFA identifies distinct underlying factors aligned with the hypothesized theoretical frameworks (TRA and HBM), validating the multidimensional nature of the questionnaire among community representatives in Kelantan.
3. The questionnaire's latent constructs, derived from the EFA process (knowledge of infectious diseases and CBS, attitudes, subjective norms, perceived benefit, perceived barriers, self-efficacy, intention to participate in CBS, and behavioural likelihood of engaging in CBS of infectious diseases), are validated and found to be reliable through CFA.
4. The structural equation model demonstrates that Knowledge of infectious diseases and CBS, together with attitudes factors (attitudes about CBS, subjective norms, and intentions) and perception factors (perceived benefits, barriers, susceptibility, and self-efficacy), significantly predict behavioural likelihood to engage in CBS of infectious diseases among community leaders in Kelantan.

Operational Definition

1. **Community representative (community leader):** in the present study, the terms community leaders, and community representatives were used interchangeably. A community leader is a community member in positions of influence within the community or has large connections with his community members, such as schoolteachers, religious leaders, and village leaders, who can provide informal reports of unusual health events or health risks that they witness in their communities (IFRC, 2017; WHO, 2019). In this study, community leaders are represented by school teachers and religious leaders in Kelantan region.
2. **Community-Based Surveillance (CBS) of Infectious Diseases:** CBS refers to the process where community representatives, such as teachers or local leaders, actively monitor and report health-related events, particularly infectious diseases, within their communities to health authorities, aiming to early detection, response, and prevention of outbreaks (Guerra, Bayugo, et al., 2019a).
3. **Knowledge of Infectious Diseases:** The level of understanding community leaders have regarding the causes, transmission, and prevention of infectious diseases. This is measured through a series of questions assessing their factual knowledge about diseases like dengue, tuberculosis, and influenza.
4. **Knowledge of CBS:** The level of understanding community leaders have regarding CBS system for infectious diseases. This is also measured by items assessing their knowledge regarding the definition and function of CBS
5. **Community-level case definition:** a simple and adaptable set of criteria that enables community members, including volunteers without formal medical

training, to identify and report signals of potential diseases, health risks, or events within their community (IFRC, 2024b).

6. **Attitude Towards CBS:** The positive or negative feelings and beliefs that community leaders hold towards participating in CBS of infectious diseases. This could include their perceived importance of CBS in disease prevention and control, and their personal willingness to engage in surveillance activities.
7. **Subjective Norms:** The perceived social pressure that community leaders feel to engage in CBS of infectious diseases. This includes the influence of peers, superiors, and other community members on their decision to participate in CBS.
8. **Intention to Participate in CBS:** The extent to which community leaders plan or are willing to participate in CBS of infectious diseases.
9. **Perception (based on the Health Belief Model):** Perception is the process by which individuals organize, interpret, and make sense of sensory information from their environment (Gaschler et al., 2021). In the context of the present study, it is the perception of community leaders regarding the severity, susceptibility, benefits, and barriers related to CBS. This includes:
 - **Perceived Susceptibility:** The community leader's belief in their community's vulnerability to infectious disease outbreaks, and/or lack of CBS of infectious diseases.
 - **Perceived Benefit:** The belief in the effectiveness of CBS in preventing or controlling outbreaks.

- **Perceived Barrier:** The perceived obstacles (e.g., lack of resources, time) to participating in CBS.
- **Self-efficacy:** perceived confidence of community leaders in performing and supporting the tasks required for effective participation in CBS of infectious diseases.

10. **Behavioural Likelihood of Engaging in CBS:** The actual or predicted behaviour of community leaders in engaging in CBS activities. This can be assessed by their stated likelihood of engaging in CBS of infectious diseases.
11. **Schoolteachers:** Teachers who work in government and private schools, providing education to diverse student populations in both public and Islamic schools. They were selected for this study due to their large connections with various community levels. Also, different other community organizations recognize them as community leaders (DHRRA Malaysia, 2022).
12. **Validity:** is the expression of the degree to which a measurement measures what it is supposed to measure, and validity is essential for a measurement tool.
13. **Reliability:** is the accuracy and precision of a measurement tool. Reliability is a measure of the degree of stability exhibited when the measurement is repeated under identical conditions.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Infectious diseases are illnesses resulting from pathogenic microorganisms, including bacteria, viruses, parasites, or fungi. These diseases can be transmitted between individuals either directly or indirectly. The WHO classified Infectious diseases into three main categories: those that cause significant mortality, those that impose substantial disability burdens on populations, and those that, due to their rapid and unpredictable spread, can have severe global consequences. (WHO, 2024b).

Infectious diseases remain a significant threat to global public health, driven by a complex interplay of biological, social and behavioural, economic, and environmental factors. The emergence and re-emergence of infectious diseases, such as malaria, yellow fever, dengue haemorrhagic fever, AIDS, anthrax, and SARS, are influenced by international trade, human mobility, and the adaptability of pathogens (Wang et al., 2024). The rapid spread of these diseases is exacerbated by global travel and trade, leading to economic disruptions beyond the health sector (Smith et al., 2019). Antibiotic resistance further complicates the control of bacterial infections, posing severe threats to public health (Ramesh et al., 2022). Effective management of infectious diseases requires an integrated approach, considering individual behaviours, community dynamics, and large-scale social forces. Public health strategies must include early warning systems, rapid response mechanisms, and robust surveillance to mitigate the impact of infectious diseases outbreaks (Meckawy et al., 2022). Additionally, cooperation between animal health and human health sectors in 'One Health' approach is crucial for understanding and controlling zoonotic diseases (Ryu et al., 2022). The socioeconomic consequences of infectious diseases necessitate

collaboration between public and private sectors to provide resources and support during outbreaks. Improved hygiene, vaccination, and social distancing are essential preventive measures (Bedson et al., 2021; Buckee et al., 2021). Overall, addressing infectious diseases requires a multifaceted strategy that encompasses social, medical, and economic dimensions to effectively reduce morbidity, mortality, and societal disruption (Dako-Gyeke et al., 2020).

2.2 Search Terms and Databases

Many search engines used in literature search including Google Scholar, Science Direct, PubMed, Scopus, and Sage Journals and other sources. The search was done using keywords related to the study and Boolean operators were used to review relevant studies. The primary search terms included "Community-Based Surveillance," "Community Health Surveillance," "Event-Based Surveillance," and "Public Health Surveillance." also, terms related to community participation, such as "Community Participation," "Willingness to Participate," and "Community Engagement," were combined with concepts like "Acceptance of Health Programs" and "Health Behaviour" to refine the search further. Literature search also include exploring factors affecting engaging in health behaviours using terms like "Factors Influencing," "Determinants," "Barriers," "Facilitators," "Perceived Benefits," and "Self-efficacy." Theoretical frameworks such as the "Health Belief Model," "Theory of Planned Behaviour," and "Theory of Reasoned Action" were included to capture studies addressing psychological and motivational aspects of CBS participation.

2.3 Burden of Infectious Diseases

Infectious diseases continue to impose a large global health burden, increasing morbidity, mortality, as well as economic stability worldwide. For instance, in 2019, TB continued the leading cause of death from a single infectious agent, with approximately 10 million people contracting the disease (WHO, 2021b). Malaria also posed a considerable threat, with 409,000 deaths reported in 2019 (WHO, 2021b). Also, antimicrobial resistance (AMR) has emerged as a serious concern (Salam et al., 2023); a study by the Global Research on Antimicrobial Resistance (GRAM) Project warns that AMR could result in over 39 million deaths by 2050 (Murray et al., 2022). Even with advancements in healthcare, the dynamic nature of infectious agents and evolving global factors contribute to the persistent challenges posed by these diseases. For example, the World Health Organization (WHO) reported that lower respiratory infections were among the top causes of death globally in 2019, underscoring the significant impact of infectious diseases on global health (WHO, 2024a).

According to the Global Burden of Disease (GBD) Study, infectious diseases are among the leading causes of death and disability globally (Institute for Health Metrics and Evaluation, 2024). The economic impact of infectious diseases is also quite significant. For instance, the combined economic burden of eight major communicable diseases—including HIV/AIDS, malaria, measles, hepatitis, dengue fever, rabies, tuberculosis, and yellow fever—has been estimated at up to US\$8 trillion (Armitage, 2021). Infectious diseases also remain a major cause of death and disability, particularly in low- and middle-income countries.

In Asia, Communicable diseases like AIDS/HIV, dengue fever, and malaria impose a large health and economic burden. AIDS cases in Central Asia have risen by 29%, particularly affecting poor communities, with varying illness costs. Dengue is

prevalent in over 100 countries, with Southeast Asia facing an annual economic burden of \$610–\$1,384 million and per capita costs of \$1.06–\$2.41. Globally, 2.9 billion people are at risk of malaria, with 90% in Asia-Pacific. Malaria control costs range from \$0.11–\$39.06 per capita annually, while elimination costs range from \$0.18–\$27. The costs of AIDS, dengue, and malaria differ across countries due to varying healthcare systems, and the economic impact of dengue and malaria is inadequately documented.

Malaysia continues to face significant challenges from infectious diseases, leading to substantial public health burdens. Tuberculosis remains one of the top five communicable diseases in the country, with thousands of cases reported annually and a notable mortality rate (Oh et al., 2024). The COVID-19 pandemic has exerted a considerable impact on TB services, leading to disruptions in diagnosis and treatment. In the Western Pacific Region, which includes Malaysia, TB case notifications experienced a significant decline during the pandemic, with a notable reduction in clinically diagnosed pulmonary and paediatric cases (Oh et al., 2024).

Dengue fever is another persistent issue in Malaysia, leading to considerable economic losses and health burdens. Dengue incidence in Malaysia peaked in 2015 and 2019, and also followed by a significant decline during the COVID-19 pandemic (Md Iderus et al., 2023). This reduction may indicate unreported cases, potentially attributable to individuals' hesitancy to seek hospital care due to fear of COVID-19 exposure. Additionally, studies have reported a reduction in dengue cases during the pandemic, attributed to movement control measures and public health interventions implemented to curb the spread of COVID-19 (Md Iderus et al., 2023).

The COVID-19 pandemic has been the most significant recent outbreak, causing numerous deaths and substantial economic disruption due to lockdown

measures. The pandemic also affected the transmission dynamics of other infectious diseases, including dengue, with observed reductions in dengue incidence during this period (Md Iderus et al., 2023).

Malaysia has also experienced outbreaks of other communicable diseases, such as the Nipah virus, which resulted in significant mortality and economic impact due to the culling of infected animals. The Nipah virus outbreak in 1998–1999 in Malaysia caused severe encephalitis and had a substantial impact on public health and the economy (Baker et al., 2021).

The impact of these diseases can be greatly reduced if the intervention occurs rapidly to contain the outbreaks before grow to be large and hard to control, this can be done by early reporting of signals of infectious diseases, specifically by the community members because they are usually the first to notice these signals

These diseases highlight the ongoing need for robust public health interventions and effective disease control programs to mitigate their impact on the Malaysian population. The recent COVID-19 pandemic has underscored the importance of strengthening public health surveillance and response systems to manage both existing and emerging infectious diseases (Baker et al., 2021). Overall, the impact of these diseases can be significantly minimized if interventions are implemented promptly to contain outbreaks before they escalate into large, uncontrollable situations. This can be achieved through the early reporting of infectious disease signals, particularly by community members (IFRC, 2024a, 2024c; WHO, 2015b).

2.4 Infectious Diseases Surveillance System

Surveillance plays a vital and indispensable role in any disease control program. It provides a comprehensive overview of the progression and overall impact of an infection or disease, enabling the measurement of preventive or therapeutic actions as they are implemented. This process helps monitor the effects of infections, interventions, health promotion strategies, and health policies, as well as supports planning and service delivery. Surveillance involves the continuous and systematic collection of routine data, which are subsequently analysed, interpreted, and used to guide actions. (Alhassan & Wills, 2024; Noah, 2021). Surveillance is fundamentally a practical process, yet it serves multiple purposes. Its primary goal is to analyse time trends, which may encompass not only overall fluctuations in numbers but also shifts in age and gender distributions, geographic patterns, and, in more advanced surveillance systems, identification of at-risk groups, such as specific social, ethnic, or occupational categories. Surveillance is crucial for assessing the impact of interventions, like mass vaccination programs, on a population, additionally, it functions as a sensitive mechanism for the early detection of outbreaks (Noah, 2021).

Outbreaks of emerging and re-emerging infectious diseases pose a major public health threat, making early detection and prompt response essential for effective disease control. These challenges have highlighted the need for innovative approaches and technologies to enhance the capabilities of traditional surveillance systems in detecting emerging infectious diseases (Wang et al., 2024). In recent years, the availability of new web-based data sources has played a significant role in advancing infectious disease surveillance (Maddah et al., 2023). However, there are still delays in reporting health events in their early stages (Bastos et al., 2019).

There are various data sources for the surveillance of infectious diseases. For example, death certification provides mortality data, though its accuracy can vary. Disease notifications report clinical features and are particularly useful for diseases with distinct symptoms, such as measles. General practitioner surveillance tracks common illnesses and infection rates. Laboratory reporting offers precise diagnoses, which are essential for managing outbreaks. Outbreak surveillance identifies disease clusters, enabling timely public health responses. Hospital admissions surveillance monitors severe illnesses like hepatitis or encephalitis (CDC, 2024). Serological surveillance evaluates population immunity and helps identify vulnerable groups to inform vaccination policies. Animal, bird, and environmental surveillance track zoonotic and emerging viruses, such as rabies, influenza, and coronaviruses. Influenza surveillance systems monitor both birds and humans, while sewage surveillance detects viruses like poliovirus (Noah, 2021). Among the various types of surveillance, EBS and CBS have emerged as some of the most significant. These approaches stand out because they enable active community participation in reporting health events at their early stages, facilitating timely interventions to contain the spread of diseases.

2.5 Event-Based Surveillance (EBS)

Event-Based Surveillance represents a paradigm shift from traditional indicator-based surveillance by enabling community participation in early disease detection. Understanding EBS concepts is crucial for this study as CBS serves as a primary signal source for EBS systems, making community knowledge, attitudes, and perceptions directly relevant to effective disease surveillance outcomes.

In public health, an event refers to any occurrence that poses a potential threat to public health and requires immediate attention, such as an emerging outbreak.

Conceptually, an event is "something that happens" and necessitates a response. In a broader sense, events may also encompass natural or man-made disasters, and some EBS systems include the reporting of such incidents. Public health events can vary greatly in scope and may include infectious disease outbreaks, the re-emergence of diseases previously eradicated in a community, foodborne disease outbreaks, chemical spills, radiation leaks, or animal disease outbreaks that pose a risk to human health (Balajee et al., 2021).

EBS involves monitoring and reporting potential events using information sources not specifically intended for surveillance. The process begins with detecting signals, or observations that alert the public health authorities to the possibility of an event occurring within a population. These signals can originate from a variety of sources, including community informants, educational institutions, public and private hospitals, the animal health sector, news outlets, and social media. The purpose of these signals is to identify potential high-priority events of concern. Signals may be used to detect disease patterns, such as clusters of similar illnesses in a community or outbreaks of disease or death in animals. They can also include individual cases of suspected high-priority events, such as a child with acute flaccid paralysis or a patient with viral haemorrhagic fever in a region at risk for Ebola Virus Disease (EVD) (Balajee et al., 2021; Clara, Do, et al., 2018).

One of the main challenges in establishing and maintaining an EBS system is designing it to keep the right balance between sensitivity and specificity. This ensures the surveillance infrastructure is not overwhelmed while still being capable of detecting high-threat events early enough. Since not all signals indicate true events, EBS can generate a significant amount of signal "noise." For instance, a pilot EBS project in Côte d'Ivoire, Vietnam, aimed at detecting a single case of suspected

cholera used the signal definition of "*anyone who has three abundant liquid stools during the day*," resulting in 1,500 signals in a single district over the course of a year. After verification and investigation, no cholera cases were found. The signal was too broad, likely capturing all cases of diarrhoea from any pathogen in the community (Clara et al., 2020). More specific definitions, such as "*acute watery diarrhoea with severe dehydration or death in any person aged 5 years or older*," have been used in other studies (Clara, Dao, et al., 2018). Achieving the right balance of sensitivity, specificity, and practicality may require piloting and revising signal definitions before finalizing them.

Due to the informal nature of signal sources, once detected, the process of triage and verification is necessary to assess the likelihood that the signal accurately represents an event. Triage involves sorting through data and information to eliminate duplicates, disinformation, irrelevant details, and false information, allowing for the identification of genuine events (Balajee et al., 2021). After triage, the verification step confirms the authenticity of the signal and triggers the collection of additional information. Once triaged and verified, the signal is considered an event (Figure 2.1). Whenever possible, EBS reporting should be integrated into existing disease reporting systems, such as the Integrated Disease Surveillance and Response (IDSR) system in the WHO African Region (WHO, 2010c), for proper response and documentation.