DEVELOPMENT AND EVALUATION OF A MOBILE APPLICATION INTERVENTION FOR EMERGENCY PREPAREDNESS AND TRIAGE PRACTICES AMONG VETERINARY PERSONNEL

By

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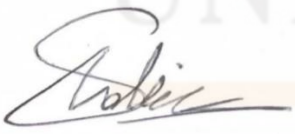

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ABSTRACT

Veterinary emergencies require rapid recognition, structured triage, and coordinated response; however, emergency preparedness within general veterinary practice is often variable. This study aimed to assess emergency preparedness and triage practices among veterinary professionals in Malaysia and to evaluate the effectiveness and usability of a newly developed veterinary emergency mobile application.

A cross-sectional pre–post intervention design was used. One hundred veterinary professionals completed a pre-intervention survey assessing emergency preparedness, triage practices, knowledge, and confidence. Participants then used the mobile application, followed by a post-intervention assessment. Emergency preparedness was measured using a weighted scoring system and Bloom's categorisation. Knowledge changes were analysed using the McNemar test, while confidence changes were analysed using the Wilcoxon Signed-Rank Test. Usability was evaluated using the System Usability Scale (SUS).

Findings revealed moderate overall emergency preparedness, with gaps in emergency drills, structured triage systems, and monitoring equipment, including capnography. Knowledge improved significantly for identifying life-threatening conditions ($p < .001$) and selecting appropriate first actions in a gastric dilation-volvulus (GDV) scenario ($p < .001$). Confidence increased significantly across all emergency domains, with large to very large effect sizes ($r = 0.510–0.841$). The mobile application achieved an SUS score of 85.65, indicating excellent usability.

In conclusion, the mobile application effectively improved emergency knowledge and confidence, and was well-accepted by users. These findings highlight the potential of digital decision-support tools in enhancing veterinary emergency preparedness and inform future directions for clinical training and practice in Malaysia.

Keywords: veterinary emergency, triage practices, emergency preparedness, mobile application, usability, System Usability Scale (SUS), confidence, knowledge improvement, Wilcoxon Signed-Rank Test, McNemar test, Malaysia

ABSTRAK

Kecemasan veterinar memerlukan pengenalpastian yang pantas, triage yang teratur, dan tindak balas klinikal yang cekap. Namun begitu, tahap kesiapsiagaan kecemasan dalam amalan veterinar am sering kali tidak konsisten. Kajian ini bertujuan menilai tahap kesiapsiagaan kecemasan dan amalan triage dalam kalangan profesional veterinar di Malaysia serta menilai keberkesanan dan kebolehgunaan aplikasi mudah alih kecemasan veterinar yang dibangunkan khusus untuk kajian ini.

Reka bentuk kajian pra–pasca intervensi telah digunakan. Seramai 100 profesional veterinar melengkapkan soal selidik pra-intervensi yang menilai kesiapsiagaan kecemasan, amalan triage, pengetahuan, dan keyakinan. Peserta kemudian menggunakan aplikasi mudah alih tersebut sebelum melengkapkan penilaian pasca-intervensi. Kesiapsiagaan kecemasan diukur menggunakan sistem markah berwajaran dan kategori Bloom. Perubahan pengetahuan dianalisis menggunakan ujian McNemar, manakala perubahan keyakinan dianalisis menggunakan Ujian Wilcoxon Signed-Rank. Kebolehgunaan dinilai melalui Sistem Skala Kebolehgunaan (SUS).

Dapatan menunjukkan bahawa kesiapsiagaan kecemasan keseluruhan adalah sederhana, dengan kekurangan dalam latihan simulasi, penggunaan sistem triage berstruktur, dan peralatan pemantauan penting seperti kapnografi. Pengetahuan meningkat secara signifikan dalam pengenalpastian keadaan mengancam nyawa ($p < .001$) dan tindakan pertama dalam kes dilatasi-volvulus gastrik (GDV) ($p < .001$). Keyakinan juga meningkat dengan ketara dalam semua domain kecemasan, dengan saiz kesan besar hingga sangat besar ($r = 0.510–0.841$). Aplikasi mudah alih tersebut menerima skor SUS 85.65, menunjukkan kebolehgunaan pada tahap “Cemerlang”.

Kesimpulannya, aplikasi mudah alih ini berkesan dalam meningkatkan pengetahuan dan keyakinan kecemasan serta diterima baik oleh pengguna. Kajian ini menonjolkan potensi alat sokongan keputusan digital dalam memperkukuh kesiapsiagaan kecemasan veterinar dan menyediakan asas bagi latihan klinikal serta pembangunan amalan kecemasan di Malaysia.

Kata kunci:

kecemasan veterinar, amalan triage, kesiapsiagaan kecemasan, aplikasi mudah alih, kebolehgunaan, Skala Kebolehgunaan Sistem (SUS), keyakinan, peningkatan pengetahuan, Ujian Wilcoxon Signed-Rank, ujian McNemar, Malaysia

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LIST OF TABLES

Table 4.12.1 Descriptive Statistics for System Usability Scale (SUS)

LIST OF ABBREVIATIONS

ABCD – Airway, Breathing, Circulation, Disability

ASEAN – Association of Southeast Asian Nations

ATT – Animal Trauma Triage

BLS – Basic Life Support

BP – Blood Pressure

CPD – Continuing Professional Development

CPA – Cardiopulmonary Arrest

CPR – Cardiopulmonary Resuscitation

COOP – Continuity of Operations Plan

DVM – Doctor of Veterinary Medicine

ECFVG – Educational Commission for Foreign Veterinary Graduates

ECG – Electrocardiography / Electrocardiogram

EPR – Emergency Preparedness and Response

$ETCO_2$ – End-Tidal Carbon Dioxide

GDV – Gastric Dilatation–Volvulus

IHCUC – Institutional Human Care and Use Committee

IQR – Interquartile Range

IV – Intravenous

MCIs – Mass Casualty Incidents

MCO – Movement Control Order

n – Sample Size Count

NASAAEP – National Alliance of State Animal and Agricultural Emergency Programs

RECOVER – Reassessment Campaign on Veterinary Resuscitation

ROSC – Return of Spontaneous Circulation

SD – Standard Deviation

SE – Standard Error

SOP – Standard Operating Procedure

SPSS – Statistical Package for the Social Sciences

SpO_2 – Peripheral Capillary Oxygen Saturation

SUS – System Usability Scale

UAT – User Acceptance Testing

UMK – Universiti Malaysia Kelantan

VR – Virtual Reality

VTL – Veterinary Triage List

WOAH – World Organisation for Animal Health (formerly OIE)

LIST OF SYMBOLS

Symbol	Meaning
%	Percentage
±	Plus–minus (standard deviation or error)
<	Less than
>	Greater than
≤	Less than or equal
≥	Greater than or equal
p	p-value (significance probability)
α	Significance level (commonly 0.05)
Z	Standardised Wilcoxon test statistic
r	Effect size (Wilcoxon Signed-Rank)
n	Number of respondents (frequency)
N	Total sample size
SD	Standard deviation
IQR	Interquartile range

CI	**Confidence interval**
√N	**Square root of sample size (used in effect size formula)**

CHAPTER 1

1.0 INTRODUCTION

Veterinary emergencies require rapid, structured decision-making, yet studies show that many general veterinary practices lack formalised emergency preparedness and triage protocols.

In Malaysia, veterinary clinics, particularly in urban areas such as the Klang Valley, face increasing pressure to respond swiftly and effectively to animal emergencies. Despite the growing demand for emergency veterinary services, many general practices operate without formalised emergency protocols or triage systems, leading to delays and compromised patient care.

This need for preparedness was underscored by a significant incident on April 1, 2025, when a gas pipeline explosion in Putra Heights, Selangor, injured over 100 people and displaced over 300 residents (Perimbanayagam, 2025; Palanisamy, 2025). Numerous animals were caught in the chaos, requiring urgent care, yet many clinics were ill-equipped to handle the sudden influx. The tragedy underscored the crucial importance of structured emergency preparedness and triage systems, not only for humans but also for animals in affected communities.

To date, there is a lack of published studies or national assessments focusing on veterinary emergency preparedness and triage practices in Malaysia. This gap in the literature underscores the urgent need for data-driven solutions tailored to the local context, rendering this study both timely and relevant.

Technology has become a transformative tool in healthcare, including the veterinary field. However, there is a lack of veterinary-specific digital tools designed for real-time triage decision-making and emergency preparedness. This study aims to address this gap by assessing the current preparedness of veterinary professionals and paraprofessionals, followed by the development and pilot testing of a mobile application that provides triage and emergency support, training, and clinic communication tools.

1.1 RESEARCH PROBLEM STATEMENT

Veterinary personnel in Malaysia may lack adequate preparedness and tools to manage emergency cases effectively due to limited training, the absence of standardised triage protocols, and inadequate communication systems within clinics. This can lead to inefficient case prioritisation and poor patient outcomes.

Despite the importance of emergency response in veterinary medicine, there are currently no published studies or national assessments focusing on emergency preparedness and triage practices among veterinary personnel in Malaysia. This lack of baseline data presents a significant gap in veterinary public health planning.

There is a critical need for an accessible, practical, and scalable solution to bridge this gap.

1.2 RESEARCH QUESTIONS

1.2.1. What is the baseline level of emergency preparedness and triage practice among veterinary professionals and paraprofessionals in Malaysia?

1.2.2. What are the existing gaps in triage protocols and emergency response capabilities?

1.2.3. Can a mobile phone application improve emergency preparedness and triage decision-making during emergencies?

1.3 RESEARCH HYPOTHESIS

1.3.1. Veterinary personnel in Klang Valley have limited emergency preparedness and inconsistent triage practices.

1.3.2. The introduction of a mobile phone application will enhance their triage accuracy, communication, and confidence during emergencies.

1.4 RESEARCH OBJECTIVES

1.4.1 General Objective

To develop and evaluate an effective mobile application intervention to support emergency preparedness and triage practices among veterinary personnel in Malaysia.

1.4.2 Specific Objectives

1.4.2.1. To assess the baseline knowledge, confidence, and emergency readiness of veterinary professionals and paraprofessionals.

1.4.2.2. To design and develop a mobile app that delivers triage tools, emergency protocols, and communication features.

1.4.2.3. To evaluate the effectiveness of the app in improving emergency preparedness, decision-making, and communication within veterinary clinics.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 The Global and Regional Landscape of Veterinary Emergency Preparedness

Emergency preparedness in veterinary medicine is increasingly recognised as a critical component of both public health and broader disaster response, extending significantly beyond the confines of individual clinical practice to contribute to overall societal resilience. The primary purpose of emergency preparedness in veterinary practice is to protect the health and well-being of patients, employees, and clients, while ensuring the continuity of essential operations during and after disasters (Texas A&M University, n.d.). This proactive stance is vital for maintaining animal welfare and supporting the recovery of affected communities.

A key framework that integrates animal health into broader disaster planning is the "One Health" approach, which emphasises the intrinsic interconnectedness of human, animal, and environmental health (NASAAEP, 2023; ASEAN, 2021). Within this integrated framework, veterinary professionals contribute indispensable expertise, particularly in addressing risks associated with zoonotic diseases, environmental hazards, and the psychological impact of critical incidents (NASAAEP, 2023). Effective pre-disaster preparedness is foundational for a robust response and recovery, necessitating the establishment of clear policies, comprehensive plans, and standardised procedures to efficiently coordinate and operationalise veterinary response resources (NASAAEP, 2023).

Despite the acknowledged importance of preparedness, many general veterinary practices, both globally and regionally, often operate without formalised emergency preparedness and triage protocols. Studies, such as one by Balieva and Ivanov (2021) focusing on Bulgarian veterinary practitioners, aim to investigate their preparedness for disaster response and the continuity of professional activities through sociological surveys (Balieva & Ivanov, 2021). Comprehensive emergency plans, as detailed in established guidelines, should encompass a wide array of elements, including hazard identification, patient population assessment, designated meeting and evacuation locations, detailed employee information, and meticulous procedures for managing hospitalised animals, patient relocation, and the preservation of medical records (Texas A&M University, n.d.).

Furthermore, these plans must address critical logistical elements such as financial continuity, appropriate insurance coverage, and facility security (Texas A&M University, n.d.).

While some practices engage in certain preparedness activities, such as maintaining medical record backups and having generators, studies reveal persistent areas requiring substantial improvement. These include the establishment of dedicated isolation and quarantine areas, as well as the implementation of effective flood mitigation strategies (Dunning et al., 2021). This pattern suggests a partial, rather than comprehensive, approach to preparedness, where certain elements are addressed while others are neglected.

A notable deficiency exists in the formal training of veterinary professionals for disaster response. A study examining veterinary students found that an overwhelming majority (96.2%) had not received formal disaster preparedness and response training as part of their core veterinary curriculum (Dunning et al., 2021). This highlights that such specialised training is not yet a standard component of professional education, thereby necessitating a greater emphasis on continuing education for practising veterinarians (Dunning et al., 2021). Similarities can be drawn from human healthcare, where comparable preparedness gaps also exist. A study involving Sudanese healthcare professionals indicated that they perceived themselves as only moderately prepared, knowledgeable, and skilled in disaster management, with specific deficiencies in their familiarity with local emergency systems and disaster triage protocols (Butta et al., 2025). This broader challenge in healthcare readiness highlights a universal need for enhanced training and standardised approaches, which are directly applicable to the veterinary sector.

A significant challenge in developing experienced emergency responders stems from the low frequency of mass casualty incidents (MCIs). This means that healthcare professionals, including veterinarians, often lack direct, hands-on experience in managing high-demand, complex events (Heldring et al., 2025). This experiential gap intensifies the need for robust simulation and training methodologies. The absence of standardised training programs and formalised protocols directly contributes to inconsistent practices across veterinary clinics, potentially leading to delays in care and compromised patient outcomes during emergencies. Securing adequate and reliable funding is a critical hurdle for developing and sustaining effective response teams, as identifying consistent, recurrent funding streams is essential for maintaining a high level of readiness and capacity (NASAAEP, 2023). The physical and mental well-being of responders is also a crucial yet often overlooked challenge, as disaster medicine can be immensely taxing, requiring proactive

strategies for stress reduction and robust support systems for veterinary personnel (NASAAEP, 2023).

The confluence of inadequate formal training and the infrequent occurrence of major emergencies creates a profound systemic vulnerability within the veterinary sector. Professionals are not systematically equipped with the necessary skills and experience for high-stakes, low-frequency events, leading to a higher likelihood of fragmented responses, inefficiencies, and suboptimal patient outcomes during actual crises. The absence of a robust, standardised educational foundation means that even well-intentioned individual practice preparedness efforts may be inconsistent or fail to integrate best practices. This systemic vulnerability extends beyond immediate animal welfare, impacting the broader "One Health" framework. A weakened veterinary response capacity can have cascading adverse effects on public health, particularly during zoonotic disease outbreaks or large-scale disasters, where animal health directly influences human health and community recovery. This critical gap strongly supports the development of interventions, such as a mobile application, that can provide repeatable, realistic training simulations and facilitate the standardisation of emergency protocols to build a more resilient veterinary workforce.

Furthermore, there appears to be a pattern in which veterinary practices prioritise and implement more immediate, visible, or less resource-intensive aspects of preparedness, such as basic equipment or routine record-keeping. However, they often struggle with, or overlook, more complex, specialised, or resource-intensive elements, such as establishing advanced isolation facilities, conducting comprehensive disaster drills, or securing dedicated funding for emergency response (NASAAEP, 2023; Dunning et al., 2021). This disparity is likely driven by perceived costs, a lack of specialised knowledge, or an underestimation of specific, less common but high-impact risks. This situation suggests that effective interventions must transcend mere information dissemination. They need to actively facilitate practical implementation, address perceived or actual resource constraints, and potentially offer scalable, cost-effective solutions. A mobile application, for instance, could serve as a practical guide, helping practices navigate and implement comprehensive preparedness strategies, even for less frequent disaster scenarios, while simultaneously highlighting the long-term benefits of sustained investment in readiness.

2.2 Foundations and Application of Veterinary Triage System

Triage is a cornerstone of emergency medicine, enabling efficient patient management under resource constraints. It is fundamentally a system for sorting patients based on the urgency of their medical needs, particularly vital when immediate, comprehensive examination of all patients is not feasible due to limited resources or a large influx of cases (Al-Ani et al., 2024; Veterinary Practice News, 2023). Its paramount importance lies in facilitating the rapid identification of urgent problems, enabling the immediate treatment of life-threatening conditions, and establishing clear prioritisation of care (Veterinary Practice News, 2023). Originating in human medicine, triage often prioritises the sickest patients to maximise the number of lives saved within a given context (Al-Ani et al., 2024).

In veterinary medicine, two widely recognised systems are the ABCD System and the Five-Points Triage System (Veterinary Practice News, 2023). The ABCD System is a straightforward and widely adopted framework for initial assessment. Each letter represents a
critical body system requiring immediate evaluation: Airway (assessing for obstruction), Breathing (checking for respiratory distress), Circulation (determining shock status and perfusion parameters), and Disability (evaluating mentation and neurological status) (Veterinary Practice News, 2023). This system provides a rapid framework for identifying life-threatening conditions. The Five-Points Triage System, adapted from human medicine, categorizes patients into five urgency groups, each with a maximum target waiting time: Red (Immediate, 0 minutes), Orange (Very Urgent, 15 minutes), Yellow (Urgent, 30-60 minutes), Green (Standard, 120 minutes), and Blue (Nonurgent, 240 minutes) (Veterinary Practice News, 2023). A 2012 study specifically modified this system for cats and dogs, incorporating 68 discriminators divided into eight subcategories (e.g., respiratory, circulatory, neurological) to guide patient categorisation (Veterinary Practice News, 2023). Despite its complexity, this system offers more specific guidelines and promotes a more consistent assessment of emergency patients (Veterinary Practice News, 2023). In broader disaster contexts, veterinary triage typically employs four categories: GREEN (animals likely to survive), YELLOW (animals likely to survive with delayed treatment), RED (critical animals that may survive with immediate lifesaving measures), and BLACK (animals that are dead or highly likely to die) (NASAAEP, 2023). Initial assessment in these

scenarios typically focuses on respiration, pulse rate/character, and neurological status (NASAAEP, 2023).

A crucial distinction in veterinary triage, compared to human civilian triage, is its emphasis on prioritising animals that require immediate care versus those whose conditions will not be jeopardised by delayed treatment (Al-Ani et al., 2024). This pragmatic approach aims to maximise the number of salvageable lives within the constraints of available resources. A fundamental principle emphasised in emergency veterinary care is the necessity of stabilising emergent cases before referral or transport (Al-Ani et al., 2024). This stabilisation-before-transport approach is paramount in any emergency or disaster scenario to
significantly improve patient survival rates (Al-Ani et al., 2024). An effective triage system also allows the veterinary team to prepare for a patient's arrival, with initial triage often beginning even over the phone (Veterinary Practice News, 2023).

Cardiopulmonary resuscitation (CPR) remains an essential intervention for dogs and cats experiencing cardiopulmonary arrest (CPA), offering the only viable method to achieve return of spontaneous circulation (ROSC) in these severe cases (RECOVER Initiative, 2024a). The 2024 RECOVER (Reassessment Campaign on Veterinary Resuscitation) guidelines provide evidence-supported CPR practices, with reported survival-to-discharge rates ranging from 5% to 7% in dogs and 1% to 19% in cats (RECOVER Initiative, 2024a). Key updates in these guidelines include tailored compression techniques, such as circumferential/2-thumb, 1-handed, and heel-of-the-hand methods, specifically designed for small animals and wide-chested breeds to enhance precision and minimise injury (RECOVER Initiative, 2024a). Furthermore, the target for end-tidal carbon dioxide (ETCO2) during CPR has been increased from 15 mmHg to 18 mmHg, aiming to improve blood flow and neurological outcomes (RECOVER Initiative, 2024a; Burkitt, 2024). Pharmacologic recommendations have also been revised, with high-dose epinephrine removed due to potential risks, and vasopressin prioritised for shockable rhythms. A single early dose of atropine is recommended when high vagal tone is suspected (RECOVER Initiative, 2024a). For non-intubated patients, tight-fitting masks or mouth-to-nose ventilation are recommended alternatives (RECOVER Initiative, 2024a). Revised defibrillation protocols now recommend doubling the second defibrillation dose to 4 J/kg, with subsequent shocks maintaining this dose (RECOVER Initiative, 2024a).

The 2024 RECOVER Basic Life Support (BLS) guidelines for small animal CPR systematically reviewed existing evidence to formulate treatment recommendations and identify knowledge gaps (Hopper et al., 2024). This comprehensive review examined 20 questions related to animal position, chest compression point and technique, ventilation strategies, and the duration of CPR cycles and chest compression pauses, resulting in 32 treatment recommendations (25 for chest compressions and 7 for ventilation) (Hopper et al., 2024). These recommendations continue to emphasise the critical importance of high-quality, uninterrupted chest compressions, with modifications suggested for chest compression techniques in wide-chested dogs (Hopper et al., 2024). When intubation is not feasible, bag-mask ventilation using a tight-fitting facemask with oxygen supplementation is recommended over mouth-to-nose ventilation (Hopper et al., 2024). It is essential to note that these recommendations were primarily based on low-quality evidence and expert opinion, highlighting the significant need for more veterinary research in this area (Hopper et al., 2024). Education and hands-on experience are considered vital for performing high-quality CPR, and the RECOVER Initiative recommends that veterinary hospitals utilise cognitive aids such as pre-stocked "crash carts" and CPR algorithm/dosage charts (Burkitt, 2024).

Despite the existence of structured triage systems, their consistent and efficient application can be challenging, particularly in high-pressure, high-stress conditions characteristic of emergencies or when there is insufficient training (Veterinary Practice News, 2023). The inherent complexity of systems like the Five-Points Triage, while offering specificity, may pose significant implementation hurdles without adequate training, practical experience, and supportive tools (Veterinary Practice News, 2023). Many general veterinary practices lack formalised triage systems altogether, which directly contributes to delays in care and potentially compromised patient outcomes. This suggests a widespread issue of ad hoc or inconsistent triage practices, rather than a systematic approach.

There is a significant and pervasive disconnect between the documented theoretical knowledge and established protocols for veterinary triage and their consistent, practical application in everyday clinical settings. This "knowing-doing" gap suggests that merely outlining a triage system in literature or guidelines is insufficient for ensuring its effective implementation. The primary challenge lies in translating these complex systems into actionable, real-time decision-making processes, especially in high-stress, dynamic, and potentially resource-limited environments. This gap is likely exacerbated by inadequate formal training and the absence of

readily accessible, user-friendly tools that can guide personnel through complex triage algorithms or provide quick and reliable references during a crisis. The consequence of this gap is often an inconsistent triage application, which directly compromises patient outcomes. This critical situation underscores the urgent need for practical, user-friendly tools that can effectively bridge this divide. A mobile application, designed to integrate established triage principles with interactive guidance and decision support, could serve as a direct conduit for consistently implementing these protocols. Such a tool would not only enhance decision-making accuracy but also promote standardisation across diverse veterinary settings, particularly benefiting less experienced personnel.

2.3 Comparison of Common Veterinary Triage Systems

Table 2.3. Comparison of ABCD System and Five-Points Triage System

Feature/System	ABCD System	Five-Points Triage System
Description/Purpose	Straightforward, widely used for initial assessment to rapidly identify life-threatening conditions.	Adapted from human medicine, categorises patients into five urgency groups with target waiting times.
Main Components/Categories	● A: Airway (obstruction) ● B: Breathing (respiratory distress) ● C: Circulation (shock, perfusion) ● D: Disability (mentation, neurological)	● Red: Immediate (0 min) ● Orange: Very Urgent (15 min) ● Yellow: Urgent (30-60 min) ● Green: Standard (120 min) ● Blue: Nonurgent (240 min)

Veterinary Adaptation Details	Applied broadly across various emergency scenarios.	A 2012 study modified for cats and dogs, using 68 discriminators across 8 subcategories (e.g., respiratory, circulatory, neurological) for categorisation.
Primary Advantage	Quick and easy framework for rapid identification of critical issues	Offers more specific guidelines for technicians, promoting homogeneous and consistent assessment
Source	(Veterinary Practice News, 2023)	(Veterinary Practice News, 2023)

2.4 Veterinary Emergency Preparedness and Triage in the Malaysian Context

While global trends and established practices provide a general framework, the specific context of Malaysia presents unique challenges and gaps in veterinary emergency preparedness and triage. This section focuses on the local landscape, drawing on available information and highlighting the critical need for localised research.

There is an explicit lack of published studies or national assessments focusing on veterinary emergency preparedness and triage practices in Malaysia. This highlights a significant research void, necessitating data-driven solutions specifically tailored to the local context. Veterinary clinics in Malaysia, particularly those located in densely urban areas such as the Klang Valley, are facing increasing pressure to provide prompt and effective responses to animal emergencies. This rising demand underscores the need to address preparedness shortcomings.

Current emergency veterinary services in Malaysia are often limited in scope and availability. Only a select group of veterinarians offer after-hours services (Animal Hospital, n.d.).

These services are typically staffed by a small team (1-2 veterinarians on night shifts) and are restricted to emergency triage, pet stabilisation, and essential surgery, with specialist services generally unavailable after hours (Animal Hospital, n.d.). This paints a picture of a resource-constrained environment, particularly outside of regular business hours. The common practice of advising clients to contact the clinic before presenting with an emergency (Animal Hospital, n.d.) suggests an attempt to manage patient flow and optimise limited resources.

However, it also implicitly indicates the absence of a robust, always-ready system capable of efficiently handling unannounced or mass casualty arrivals.

The gas pipeline explosion in Putra Heights, Selangor, on April 1, 2025, serves as a stark and recent example of the critical need for structured emergency preparedness for animals in Malaysia. During this incident, a substantial number of animals were caught in the chaos, requiring urgent care. Yet, many local clinics were ill-equipped to handle the sudden influx of cases, highlighting a severe capacity gap (Perimbanayagam, 2025). The response efforts largely relied on the swift actions of volunteer organisations, such as Persatuan Haiwan Terbiar Malaysia (SAFM) and SPCA Selangor. These groups, along with individual veterinarians such as Dr. Bryan Low, played a crucial role in rescuing 59 cats, 8 dogs, and 2 snakes and providing treatment to injured animals (Perimbanayagam, 2025). This reliance on informal networks and volunteerism underscores the systemic absence of formalised governmental or coordinated veterinary disaster response. The Putra Heights incident explicitly revealed the lack of an official animal disaster response unit in Malaysia, though promising discussions are reportedly underway to establish one (Perimbanayagam, 2025). This points to a significant institutional and governmental gap in disaster preparedness for animals.

In the absence of a formal, government-backed, or standardised veterinary emergency response infrastructure, Malaysia's animal emergency management heavily relies on uncoordinated volunteer groups and individual clinics. This reliance on informal networks, while commendable for its immediate impact, inadvertently masks fundamental systemic deficiencies, leaving them to be addressed by heroic, ad hoc individual and organisational efforts. It implies a lack of scalable, sustainable, and consistently high-quality response capabilities. The "ill-equipped" status of clinics and the limited after-hours services (Animal Hospital, n.d.) are direct symptoms of this underlying lack of formalisation, investment, and structured planning. This informal reliance can lead to volunteer burnout, inconsistent standards of care, and a fragmented

response that is inherently not optimised for large-scale or prolonged incidents. This situation underscores the urgent need for a structured and formalised approach to animal emergency response in Malaysia. The proposed mobile application, by providing standardised protocols, real-time guidance, and communication tools, can serve as a crucial interim step towards professionalising and standardising the response, even before official governmental units are fully established. It has the potential to empower individual clinics and veterinary personnel to act more effectively and cohesively, thereby reducing the unsustainable burden on informal networks and significantly improving overall animal welfare outcomes during emergencies.

Veterinary personnel in Klang Valley may lack adequate preparedness and tools to manage emergency cases effectively due to limited training, the absence of standardised triage protocols, and inadequate communication systems within clinics. These deficiencies can lead to inefficient case prioritisation and suboptimal patient outcomes. The pervasive lack of baseline data on emergency preparedness and triage practices across Malaysia makes a precise quantitative assessment of these gaps challenging. However, the qualitative evidence from incidents like Putra Heights strongly corroborates their existence and impact. The broader ASEAN strategy for animal health emergencies acknowledges that countries in Southeast Asia face dynamic hazards and complex risk pathways, necessitating continuous updates to plans and strengthening preparedness (ASEAN, 2021). This regional context further validates the identified gaps within Malaysia.

The consistent lack of published studies or national assessments on veterinary emergency preparedness and triage practices in Malaysia is a critical finding in itself. This absence signifies a substantial research gap that the proposed study aims to address. By conducting a data-driven assessment tailored to the local context, this study is well-positioned to provide invaluable insights for clinical and policy-level improvements specific to Malaysia. As a developing, newly industrialised country (Mohamad et al., 2021), Malaysia faces unique challenges in disaster risk reduction, which inherently extends to animal health. The development of integrated disaster risk assessment frameworks is still an ongoing process within the country (Mohamad et al., 2021), further highlighting the nascent stage of comprehensive disaster preparedness.

The critical absence of baseline data and localised empirical research, specifically on veterinary emergency preparedness and triage practices within Malaysia, creates a profound "data-driven policy vacuum." Without robust, localised empirical evidence, it becomes exceedingly difficult for policymakers, professional veterinary bodies, and even individual clinics to accurately

identify specific needs, allocate scarce resources effectively, and develop targeted, evidence-based training programs and standardised protocols. This lack of data fundamentally impedes evidence-based decision-making and obstructs the systematic improvement of emergency response capabilities. The proposed study, by aiming to be a data-driven assessment in this domain, is not merely filling an academic gap. It is a critical prerequisite for meaningful policy development and strategic resource allocation in Malaysia's veterinary sector. The mobile application, informed by this baseline data, can then become a practical, scalable tool that helps bridge existing operational gaps, providing a tangible model for how technology can address specific local challenges in a data-informed, systematic manner.

2.5 Leveraging Technology for Enhanced Emergency Preparedness and Triage

Technology has emerged as a powerful enabler in various healthcare domains, including emergency response. This section examines the existing landscape of digital tools in both human and veterinary medicine, identifying the specific gap that the proposed mobile application aims to address for veterinary personnel.

Technology has profoundly transformed healthcare practices, including emergency management. Mobile health (mHealth) applications demonstrate considerable promise in facilitating responses to medical emergencies. A systematic review revealed that a significant proportion (39%) of relevant studies focused on warning systems for emergency services, while 21% were dedicated to disaster management applications (Plaza Roncero et al., 2020). This highlights the established utility of mobile technology in crisis scenarios. Applications such as PulsePoint Respond exemplify how 911-connected apps can provide immediate notifications of community emergencies (e.g., cardiac arrest requiring CPR, wildland fires, flooding, utility disruptions) (PulsePoint Respond, 2025). These apps can also offer real-time access to dispatch radio traffic, fostering a "Culture of Action" within the community (PulsePoint Respond, 2025). This demonstrates the potential for rapid, location-specific information dissemination and enhanced public engagement in emergency response. Virtual reality (VR) stands out as a highly promising tool for delivering realistic and repeatable simulation training for healthcare professionals, particularly in the context of mass casualty incidents (MCIs) (Heldring et al., 2025).

VR training is effective in narrowing the theory-practice gap and significantly improving preparedness, with high levels of user acceptability and applicability (Heldring et al., 2025). This validates the efficacy of digital simulation platforms for high-stakes, infrequent events.

The veterinary field has increasingly integrated digital tools, primarily in practice management. Software solutions like Digitail offer comprehensive, all-in-one platforms encompassing health records, online appointment scheduling, invoicing, stock management, and even AI-powered assistance for tasks such as SOAP notes and treatment planning (Pui, 2025). These cloud-based systems enhance operational efficiency and patient engagement by providing remote accessibility (Pui, 2025). For pet owners, a range of mobile applications and online tools are available, including VetTriage (VetTriage, 2024) and Petriage (Introducing Petriage, 2025). These platforms allow pet parents to engage in live video consultations with veterinarians (VetTriage, 2024) or utilise symptom checkers to assess the urgency of their pet's health concerns (Introducing Petriage, 2025). They provide real-time results, next-step recommendations, and can facilitate the sharing of medical records with the family veterinarian, often with the aim of reducing unnecessary emergency hospital visits (VetTriage, 2024; Introducing Petriage, 2025). Several digital toolkits are available to support veterinary clinics in emergency planning and preparedness, including the Best Friends Emergency Preparedness Toolkit (Emergency Preparedness Toolkit & Resources, 2023). This resource offers templates for hazard analysis, evacuation action plans (EAPs), and continuity of operations plans (COOPs). However, these are primarily static planning documents designed for creating protocols, rather than dynamic, interactive tools for executing real-time triage or emergency protocols during a crisis.

Despite advancements in digital tools, a critical void persists: a lack of veterinary-specific digital tools designed for real-time triage decision-making and emergency preparedness for veterinary personnel. Existing pet-owner-focused applications (VetTriage, 2024; Introducing Petriage, 2025) are primarily designed for client-facing symptom assessment and remote consultation, not for direct use by veterinary professionals actively managing an emergency case within a clinical or field setting. While practice management software (Pui, 2025) streamlines administrative and operational workflows, it typically does not incorporate integrated, interactive triage flowcharts or comprehensive emergency protocols for real-time clinical decision support during a crisis. Similarly, existing planning toolkits (Emergency Preparedness Toolkit & Resources, 2023) provide templates for developing emergency plans but do not function as

dynamic, interactive guides for executing triage or emergency response protocols in the immediate moment of a crisis.

While digital tools are prevalent in veterinary care (e.g., for administrative efficiency, client communication, or remote pet-owner advice), a critical missing piece remains: a dedicated digital tool tailored for veterinary professionals at the immediate point of care during an emergency.

This represents a "last mile" gap in the digital transformation of veterinary emergency medicine. Existing tools primarily optimise administrative tasks or empower pet owners, but they do not directly address the immediate, high-stakes, and complex clinical decision-making needs of veterinary professionals in emergency rooms or disaster field settings. This specific gap is likely attributable to the inherent complexity of translating established medical protocols into real-time interactive decision support, the need for seamless integration with clinical workflows, and perhaps a slower adoption curve for such highly specialised tools compared to broader practice management solutions. Bridging this "last mile" gap with a purpose-built mobile application is not merely an incremental technological upgrade; it is a transformative step. Such an application would not only significantly enhance the competence and confidence of individual practitioners but also promote standardised care delivery across a diverse range of clinics, particularly those with limited resources or access to specialised training. This directly addresses the core problem statement by offering a practical, scalable, and accessible solution for real-time support, moving beyond mere administrative efficiency to directly impact clinical outcomes during critical emergencies.

A purpose-built mobile application can serve as an invaluable intervention by providing interactive triage flowcharts, comprehensive educational modules (e.g., on cardiopulmonary resuscitation (CPR), shock management, and crash cart preparation), and integrated communication features. This directly supports enhanced decision-making, knowledge acquisition, and inter-team coordination. The mobile nature of the application ensures widespread accessibility, even in environments with limited or no internet connectivity, making it a practical tool for diverse clinical settings, including those with resource constraints. Drawing parallels from human VR studies (Heldring et al., 2025), the app's potential to offer repeatable simulation training could significantly benefit veterinary personnel, allowing them to practice critical decision-making in a low-stakes, controlled environment. By providing real-time, on-demand decision support, a

mobile application can effectively bridge the "knowing-doing" gap in triage application (as identified in Section 6.2), translating theoretical knowledge into consistent practical action.

2.6 Rationale for a Mobile Phone Application Intervention

This section synthesises the critical gaps identified throughout the literature review, providing a robust justification for developing and evaluating a mobile application as a targeted, practical, and scalable solution to enhance veterinary emergency preparedness and triage practices.

The comprehensive literature review consistently reveals significant and pervasive gaps in veterinary emergency preparedness and triage across multiple dimensions. These include a widespread lack of formalised protocols and structured training in general veterinary practices, as supported by studies on veterinary student preparedness (Dunning et al., 2021). A notable "knowing-doing" gap exists in the consistent application of established triage principles, where theoretical knowledge does not always translate into standardised, effective real-time decision-making (Al-Ani et al., 2024; Veterinary Practice News, 2023). The Malaysian context presents unique and compounding deficiencies, characterised by limited resources, a reliance on informal and volunteer-driven responses during crises, and a critical absence of localised data or official national animal disaster response units (Animal Hospital, n.d.; Perimbanayagam, 2025). Furthermore, while technology has made inroads into human emergency response and certain facets of veterinary practice (e.g., administrative software, client-facing apps), there remains a distinct and unmet need for a veterinary-specific mobile application that provides real-time, interactive decision support directly for professionals during emergencies (Pui, 2025; VetTriage, 2024; Introducing Petriage, 2025).

The proposed mobile phone application is designed to directly address these multifaceted gaps. By offering interactive triage flowcharts, comprehensive educational modules, and integrated communication features, it serves as a highly targeted solution to improve decision-making accuracy, enhance knowledge retention, and foster better coordination among veterinary personnel. Its inherent mobile nature ensures widespread accessibility, even in environments with limited or no internet connectivity. This makes it an exceptionally practical tool for diverse clinical settings, including those operating with constrained resources. The app's capacity for real-time

decision support and its potential to facilitate repeatable training exercises (drawing parallels from the efficacy of VR simulations in human medicine (Heldring et al., 2025)) position it as a highly scalable solution for elevating emergency preparedness across a multitude of clinics and individual veterinary professionals. By providing a structured, digital framework, the application can standardise emergency practices, reduce reliance on ad hoc decision-making, and effectively mitigate the negative impacts stemming from limited formal training.

The mobile phone app is not merely an incremental technological addition; it functions as a catalyst for systemic change within veterinary emergency response. By offering accessible, on-demand, and standardised guidance, it directly bridges the gap between theoretical best practices (what should be done) and practical implementation (what can be done, even with existing resource limitations). It democratizes access to critical knowledge and standardised procedures, thereby empowering individual veterinary personnel who may not have access to extensive formal training programs or immediate specialist consultation. This catalytic role is particularly vital in regions like Malaysia, where formal emergency infrastructure is still in its nascent stages. This catalytic effect can lead to a more consistent, higher-quality standard of emergency care delivered across a wider spectrum of veterinary clinics, ultimately improving overall animal welfare outcomes. Furthermore, by facilitating standardised data collection and enhancing internal communication (features implicitly supported by a comprehensive app), it could contribute to building a more robust data foundation for future national assessments and evidence-based policy development. This directly addresses the "data-driven policy vacuum" identified earlier (Section 6.3), positioning the app as a foundational component for building a more resilient and responsive veterinary emergency system from the ground up, moving from ad-hoc responses to a more structured and professionalised approach.

The intervention is expected to lead to a measurable improvement in participants' self-reported confidence, overall preparedness levels, and critical decision-making capabilities during emergencies. By actively encouraging and facilitating the adoption of structured emergency response protocols, this project is anticipated to significantly contribute to improved animal health outcomes and enhanced clinical efficiency across veterinary settings. Crucially, the study aligns with and supports broader "One Health" initiatives by substantially enhancing veterinary response capacity. This directly influences public health, particularly in the context of large-scale disaster

scenarios or the management of zoonotic outbreaks (NASAAEP, 2023). The integral component of gathering user feedback will ensure the app's continued relevance, usability, and adaptability, thereby paving the way for its potential scalability and broader adoption across veterinary practices throughout Malaysia.

2.7 Identified Gaps in Veterinary Emergency Preparedness and Proposed Mobile Phone App Solutions

Table 2.7. Identified Gaps in Veterinary Emergency Preparedness and the Role of the Mobile Application

Identified Gap	How Mobile App Addresses the Gap	Anticipated Benefit
Lack of formalised emergency preparedness and triage protocols in general practices. (Dunning et al., 2021)	Provides interactive triage flowcharts and emergency protocols.	Standardisation of emergency care and decision-making.
Inconsistent application of established triage principles ("knowing-doing" gap). (Al-Ani et al., 2024; Veterinary Practice News, 2023)	Offers real-time, step-by-step guidance during emergencies.	Improved decision-making accuracy and consistency.
Limited formal training and experience in disaster response for veterinary personnel.	Delivers comprehensive educational modules and supports repeatable simulation training.	Enhanced knowledge, skills, and confidence during crises.

(Dunning et al., 2021; Heldring et al., 2025)		
Inadequate communication systems within clinics during emergencies.	Integrates communication features for inter-team coordination.	Better intra-clinic communication and coordinated response.
Absence of localised data and official animal disaster response units in Malaysia. (Perimbanayagam, 2025; Mohamad et al., 2021)	Facilitates data collection on preparedness and app usage for future analysis and evaluation.	Contribution to localised data for evidence-based policy and infrastructure development.
Resource constraints in Malaysian clinics (e.g., limited after-hours staff, lack of specialists). (Animal Hospital, n.d.)	Offers accessible, on-demand support and offline functionality.	Practical, low-cost tool supporting clinics with limited resources.
Reliance on informal/volunteer-driven responses during crises. (Perimbanayagam, 2025)	Empowers individual clinics and personnel with standardised tools, thereby reducing reliance on ad-hoc solutions.	Professionalisation and standardisation of animal emergency response.

CHAPTER 3

3.0 MATERIALS AND METHODS

3.1 Study Area

This study was conducted in the Klang Valley region of Malaysia, comprising Selangor and Kuala Lumpur. The area was selected due to its high concentration of veterinary clinics, diverse emergency caseload, and increased demand for rapid emergency response capabilities. Urban clinics in this region often manage high volumes of emergency cases yet frequently lack structured emergency preparedness protocols or standardised triage systems. Klang Valley, therefore, provides an ideal setting to examine baseline preparedness levels and evaluate a mobile application intended to support emergency decision-making in real clinical environments.

3.2 Study Design

A quasi-experimental pre–post intervention design was employed. This design enables the evaluation of changes over time in participants' emergency preparedness, triage practices, and self-reported confidence following exposure to a mobile application intervention.

The study consisted of three phases:

3.2.1. Pre-intervention phase

Participants completed a baseline online questionnaire that assessed their current emergency preparedness levels, availability of emergency equipment, training history, triage practices, and confidence in handling emergency situations.

3.2.2. Intervention phase

Participants installed and used a prototype mobile application developed specifically for this research. The application included interactive triage flowcharts, emergency reference modules, CPR and shock management guidelines, and offline accessibility for clinics with limited internet connectivity.

3.2.3. Post-intervention phase

Following app usage, participants completed a second questionnaire consisting of repeated baseline questions, the System Usability Scale (SUS), and open-ended items to evaluate user experience and perceived effectiveness.

The quasi-experimental design was chosen because randomisation is not feasible in real-world clinical settings, and the study aimed to measure practical improvements following the introduction of a digital intervention.

3.3 Study Population

The study population consisted of veterinarians, veterinary technicians, veterinary nurses, and veterinary assistants currently working in veterinary clinics or hospitals in the Klang Valley. This population was selected because:

3.3.1. They are directly involved in handling emergency cases.

3.3.2. They make primary decisions regarding triage and stabilisation.

3.3.3. Their preparedness level has a direct impact on patient outcomes.

3.3.4. They represent the intended end-users of the mobile application.

No restrictions were placed on clinic type; private, public, and mixed animal practices were included.

3.4 Inclusion Criteria

Participants were eligible if they met the following:

3.4.1. Actively working in a veterinary clinic or hospital.

3.4.2. Involved in clinical duties where emergency cases may be encountered.

3.4.3. Willing and able to complete both pre-intervention and post-intervention questionnaires.

3.4.4. Have access to an Android mobile device compatible with the app.

3.5 Exclusion Criteria

Participants were excluded if:

3.5.1. They were not involved in clinical work (administration-only, research-only roles).

3.5.2. They declined or were unable to complete both surveys.

3.5.3. They did not have access to a suitable mobile device to install the application.

3.6 Sampling Method

A purposive sampling method was employed to recruit veterinary personnel from private and public clinics throughout Klang Valley. This approach ensured that all participants had direct

clinical responsibilities and practical exposure to veterinary emergency cases, thereby enhancing the relevance and applicability of the data collected.

Recruitment strategies included direct outreach via email, WhatsApp, and phone calls, as well as professional networking and in-person clinic visits. Participants were also encouraged to share the invitation with eligible colleagues, allowing efficient dissemination within the veterinary community.

Although the initial target sample size was 50 participants, the study successfully obtained 100 complete responses. This exceeded the original expectation and strengthened the reliability, representativeness, and statistical power of the analysis. The larger sample size enabled a broader overview of emergency preparedness and triage practices within the Klang Valley, thereby enhancing the sensitivity of the pre- and post-intervention comparison within the quasi-experimental design.

3.7 Development of the Mobile Application Intervention

3.7.1 Content Development

The mobile application was developed as a clinical decision-support and educational tool for veterinary emergency scenarios. All content—triage algorithms, emergency protocols, CPR guidelines, shock management steps, and crash cart references—was generated based on:

- Published veterinary emergency and critical care guidelines
- Recommendations from relevant international bodies (e.g., RECOVER CPR, NASAAEP)
- Practical workflows observed in small-animal emergency medicine

A panel of veterinarians with emergency experience reviewed all content to ensure clinical accuracy and contextual relevance to Malaysian veterinary practice.

3.7.2 App Features

The mobile application included:

- **Interactive triage flowcharts** guide users through emergency classification (e.g., Airway-Breathing-Circulation-Disability-Exposure), colour-coded by urgency categories.

- **Condition-specific decision algorithms**, such as for seizures, polytrauma, respiratory distress, and shock.

- **Emergency educational modules**, covering CPR, crash cart preparation, toxin exposure, wound management, and stabilisation principles.

- **Offline accessibility**, ensuring usability in clinics with poor connectivity.

- **A simplified, low-cognitive-load interface** optimised for rapid decision-making under pressure.

The application was delivered as an Android APK file suitable for research testing.

3.7.3 Validation and Pilot Testing of the Mobile App

The application underwent several forms of validation:

1. **Content validation**
   Conducted by subject matter experts to verify correctness, clinical soundness, and relevance.

2. **Face validation**

Conducted with a small group of clinicians to assess clarity, navigation ease, and suitability for real-world clinical contexts.

3. **User acceptance testing (UAT)**

Participants trialled the app during the intervention period and provided feedback, informing minor refinements before the full post-test deployment.

3.8 Measurement Tools

3.8.1 Baseline (Pre-intervention) Questionnaire

The online pre-test questionnaire assessed four domains:

1. **Demographics** – role, years of experience, clinic type, state.

2. **Emergency Preparedness** – presence of protocols, equipment, crash cart, SOPs, drills, CPR training history.

3. **Triage Practices** – use of triage systems, approach to case prioritisation, recognition of critical signs.

4. **Self-evaluated Confidence** – Likert-scale items measuring confidence in handling CPR, seizures, shock, trauma, and other emergency scenarios.

The questionnaire was developed in accordance with established emergency preparedness guidelines and adapted for the Malaysian veterinary context.
Content validity was ensured through expert review, and reliability was assessed using Cronbach's alpha, with a value of ≥ 0.70 considered acceptable.

3.8.2 Weighted Emergency Preparedness Scoring System

A weighted scoring system was used to quantify emergency preparedness by classifying items into three tiers based on their impact on clinical outcomes: Critical (weight 3), Essential (weight 2), and Supportive (weight 1). This hierarchical structure reflects established practices in emergency preparedness evaluation, in which higher-tier indicators carry a greater influence on response effectiveness.

Similar tiered approaches are widely used in public health and veterinary emergency systems. Public health emergency evaluation tools typically assign critical response capabilities to wider scoring ranges (e.g., 0–6), essential logistics to moderate ranges (0–4), and supportive resources to minimal ranges (0–2), thereby improving predictive performance by distinguishing high-impact indicators. Veterinary trauma triage systems, such as the ATT score, also prioritise critical physiologic parameters, with mid-range scoring for neurologic factors and binary scoring for supportive findings.

International frameworks, such as the WOAH Emergency Preparedness and Response (EPR) pathway, employ a comparable tiering system, ranking simulations, deployment capacity, and response readiness as the highest category, followed by planning capacities and supportive infrastructure.

Using this evidence-based rationale, weighted preparedness scores in this study were summed to produce a total score out of 50.

Bloom's cut-off points were applied to categorise overall preparedness scores in this study. This method is widely used in public health and knowledge–practice assessments, where total scores are classified into three categories: High (80–100%), Moderate (60–79%), and Low (<60%). The approach is supported by multiple studies. For example, a study assessing knowledge, attitude, and preventive practices related to COVID-19 categorised scores using the exact same Bloom's thresholds (<60% poor, 60–79% moderate, 80–100% good) across all domains (Feleke et al., 2021). Similarly, research evaluating community practices toward a public health issue applied an identical Bloom-based categorisation, defining high (80–100%), moderate (60–79%), and low (<60%) performance levels (Dejene et al., 2022).

This scoring system allows structured and interpretable classification of preparedness across clinics.

3.8.3 Post-intervention Questionnaire

The post-test questionnaire included:

3.8.3.1. Repeated items from the baseline for comparison

3.8.3.2. System Usability Scale (SUS) to evaluate app usability

3.8.3.3. Additional questions on perceived usefulness, functionality, and areas for improvement

3.8.3.4. Open-ended questions to gather detailed user insights

The SUS score was calculated according to standardised scoring guidelines (0–100 scale).

3.9 Study Implementation Flow

3.9.1. Phase 1: Pre-intervention

3.9.1.2. Participants received the study information sheet and provided informed consent.

3.9.1.3. The baseline questionnaire was administered via Google Forms.

3.9.1.4. Participants received installation instructions for the mobile application.

3.9.2. Phase 2: Intervention

3.9.2.1. Participants used the app for several days in their own clinical environment.

3.9.2.2. They were encouraged to apply the app during routine emergency case handling or simulated scenarios.

3.9.2.3. Technical support was made available during the intervention period.

3.9.3. Phase 3: Post-intervention

3.9.3.1. Participants completed the post-test questionnaire.

3.9.3.2. SUS data and qualitative feedback were collected.

3.9.3.3. Preparedness and confidence scores were compared to baseline.

3.10 Data Analysis

3.10.1 Data Preparation

Data were exported from Google Forms to Microsoft Excel, screened for errors, and imported into SPSS Version 28 for analysis.

3.10.2 Descriptive Statistics

- Categorical variables summarised using frequency and percentage
- Numerical variables summarised using mean ± SD or median (IQR)
- Preparedness scores categorised using Bloom's cut-off

3.10.3 Normality Assessment

The Shapiro–Wilk test was used to assess the normality of the data for the preparedness and confidence domains.

3.10.4 Pre–Post Comparison Tests

Depending on normality:

- **Paired t-test** for normally distributed data
- **Wilcoxon signed-rank test** for non-normal data

These tests compared:

- Preparedness scores
- Confidence levels
- Reported triage practices

3.10.5 Effect Size Calculation

$$r = \frac{Z}{\sqrt{N}}$$

Effect size categories:

- **Small** = 0.10
- **Medium** = 0.30
- **Large** = 0.50

Effect sizes enhance the interpretation of practical significance beyond p-values.

3.10.6 SUS Scoring

SUS items were scored according to established guidelines. A score of:

- ≥ 68 indicated above-average usability
- < 68 suggested below-average usability

Qualitative feedback was subjected to thematic categorisation to identify usability issues, strengths, and suggestions for improvement.

3.11 Ethical Considerations

This study adheres to the ethical standards for research involving human participants. Ethical clearance was obtained from the UMK Human Research Ethics Committee prior to the commencement of data collection. Participants were provided with informed consent on the Google form, which outlined the study's purpose, procedures, risks, and rights, including the right to withdraw at any time without consequence. All responses will remain anonymous and confidential, with no identifying information collected. Data will be securely stored and used solely for academic research purposes.

CHAPTER 4

4.0 RESULTS

4.1 Demographic Characteristics of Respondents

A total of 100 veterinary personnel participated in this study, representing clinics across the Klang Valley region. The majority of respondents were from Selangor (61%), followed by Wilayah Persekutuan Kuala Lumpur (39%), indicating a balanced participation between the two main urban veterinary hubs. In terms of professional roles, most participants were veterinarians (76%), while the remainder comprised veterinary assistants (21%), veterinary nurses (2%), and one veterinary technician (1%), reflecting a workforce predominantly made up of clinicians supported by paraprofessionals.

Respondents also varied in their years of clinical experience. A small proportion had less than one year of experience (10%), whereas 20% had practised for one to three years. The largest group reported four to seven years of experience (59%), indicating that the sample primarily consisted of mid-career veterinary professionals. Additionally, 11% had more than seven years of experience, representing highly experienced practitioners.

Regarding practice type, most respondents were from small animal practices (79%), while 20% worked in mixed-animal clinics. Only one respondent (1%) was from a university veterinary hospital. This distribution reflects the predominance of small animal practice in the Klang Valley region and provides context for interpreting emergency preparedness and triage practices within predominantly companion animal clinical settings.

Table 4.1. Respondents' Demographic Characteristics

Demographic Characteristics		Total (n=100)	
		n	%
State	Selangor	61	61
	W.P. Kuala Lumpur	39	39
Profession	Veterinarian	76	76
	Veterinary assistant	21	21
	Veterinary nurse	2	2
	Veterinary technician	1	1
Years of Experience	< 1 year	10	10
	1–3 years	20	20
	4–7 years	59	59
	> 7 years	11	11
Type of Practice	Small animal	79	79
	Mixed practice	20	20
	University hospital	1	1

4.2 Reliability Analysis

Cronbach's alpha was calculated for all Likert-scale items in the questionnaire, including perceived preparedness, confidence items, and usability items. The combined scale demonstrated a Cronbach's alpha of 0.823, indicating good internal consistency. This confirms that the items reliably measured related constructs and were suitable for further analysis.

4.3 Emergency Preparedness

This section describes the baseline emergency preparedness of participating clinics, assessed using 11 structural, resource, and capability-level indicators (Q6–Q13). The results reveal strong foundational preparedness in several areas, but substantial gaps in critical emergency capabilities.

4.3.1 Item-Level Emergency Preparedness

Most clinics did not have a written emergency or disaster protocol, with only 35% reporting the presence of a formal SOP and 57% indicating they had no protocol in place. Emergency equipment availability was generally high: 94% of clinics had an emergency crash kit, 95% had a power backup system, and 91% maintained essential emergency supplies for staff and patients.

A designated emergency meeting or assembly point was available in 97% of clinics, demonstrating strong compliance with basic emergency planning components.

Capability-based preparedness varied substantially. Endotracheal intubation, a critical emergency skill, was available in 67% of clinics, while 33% of respondents were unsure whether their clinic possessed this capability.

Monitoring equipment availability showed a sharp contrast between essential and advanced tools.

- Pulse oximetry and blood pressure monitoring were universally available (100%),
- ECG machines were reported in 94% of clinics,
- But capnography, one of the most important monitoring tools in emergency and anaesthetic cases, was available in only 7% of clinics.

This represents a significant gap in critical monitoring capability and aligns with global findings that capnography is often underutilised in general practice settings.

Emergency drills were infrequently practised:

- Only 2% of clinics conducted drills regularly,
- 17% conducted them occasionally,
- A large majority (81%) reported no emergency drills at all.

This highlights a major deficit in staff training and coordinated emergency response readiness.

Table 4.3.1. Item-Level Emergency Preparedness Indicators

Emergency Preparedness Indicators	**Total (n=100)**					
	Yes		**Not sure**		**No**	
Item	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**

Written emergency/disaster protocol (SOP)	35	35	8	8	57	57
Emergency crash kit	94	94	2	2	4	4
Emergency power backup	95	95	2	2	3	3
Emergency supplies (food/water/medications)	91	91	2	2	7	7
Designated meeting/assembly point	97	97	3	3	0	0
Endotracheal intubation capability	67	67	33	33	0	0
Monitoring Equipment						
– ECG	94	94	0	0	6	6
– Capnography	7	7	0	0	93	93
– SpO_2 pulse oximeter	100	100	0	0	0	0
– Blood pressure monitor	100	100	0	0	0	0

	Yes, regularly		**Yes, once/rarely**		**No**	
Item	**n**	**%**	**n**	**%**	**n**	**%**

Emergency drills or simulations	2	2	17	17	81	81

4.3.2 Weighted Objective Preparedness Score (OPS-W)

Using the three-tier weighting model, where critical indicators (e.g., capnography, ECG, intubation, emergency drills, BP monitoring) were assigned the highest weight, the total possible preparedness score was 50.

Scores among clinics ranged from 21 to 47, with a mean of 34.71 ± 4.725, indicating moderate overall preparedness. Although clinics performed well in essential and supportive indicators, the low availability of capnography and the lack of emergency drills substantially reduced scores across the cohort.

Table 4.3.2. Weighted Objective Preparedness Score (OPS-W) (N = 100)

Statistic	Value
Minimum score	21
Maximum score	47
Mean	34.71
Standard deviation	4.72538
Maximum possible score	50

4.3.3 Preparedness Categorisation (Bloom's Cut-Off)

The majority of clinics, therefore, fell within the moderate preparedness category, consistent with the mean OPS-W score. The relatively small proportion of clinics reaching the highest category reflects limited fulfilment of critical preparedness indicators such as capnography availability and regular emergency drills.

Table 4.3.3. Preparedness Levels According to Bloom's Cut-Off (N = 100)

Preparedness Level	n	%
Low preparedness	10	10
Moderate preparedness	79	79
High preparedness	11	11

4.3.4 Summary of Emergency Preparedness Findings

In summary, veterinary clinics demonstrated moderate overall emergency preparedness, with strengths in basic resources but clear gaps in critical capabilities. Although essential items such as crash kits, power backup, and emergency supplies were widely available, advanced monitoring tools—particularly capnography—and structured emergency protocols were limited. Emergency drills were also rarely conducted, reflecting gaps in staff training and readiness for coordinated responses. These limitations were mirrored in the weighted preparedness scores and Bloom's categorisation, where most clinics fell within the moderate preparedness level, with only

a small proportion achieving high preparedness. Collectively, these findings highlight the need for improved investment in advanced monitoring equipment, formalised emergency SOPs, and routine simulation training to enhance emergency readiness.

4.4 Perceived Preparedness

Perceived preparedness was assessed using a single 5-point Likert-scale item (Q14), in which respondents rated their level of preparedness regarding their clinic's ability to handle emergency situations. The mean perceived preparedness score was 3.81000 ± 0.52599, with scores ranging from 3.00 to 5.00.

Most respondents rated their preparedness at the higher end of the scale, with 69% selecting a score of 4, 25% selecting a score of 3, and 6% selecting the maximum score of 5. These results indicate that respondents generally perceived their clinics as moderately to highly prepared for emergency situations.

However, when compared to the Objective Preparedness Score (OPS-W) and the limited availability of critical emergency tools, such as capnography, the perceived preparedness ratings appear relatively optimistic. This discrepancy suggests that respondents may base their perceptions on routine operational experience rather than on the presence of critical emergency infrastructure and training components.

Table 4.4.1 Perceived Preparedness Score Distribution (N = 100)

Rating	Freq	%
1 (Not prepared)	0	0
2 (Slightly prepared)	0	0

3 (Moderately prepared)	25	25
4 (Well prepared)	69	69
5 (Very well prepared)	6	6

Table 4.4.2. Perceived Preparedness Score Summary

Statistic	Value
Minimum	3
Maximum	5
Mean	3.81
Standard deviation	0.52599

4.5 Triage Practices

4.5.1 Use of Formal Triage

Clinics demonstrated varied use of formal triage procedures. Only 4% reported always using a formal triage process, while 46% used one "sometimes." Another 38% indicated that they rarely used formal triage, and 12% reported never using a formal triage system. These findings show that structured, standardised triage procedures are not widely implemented in most clinics.

Table 4.5.1. Frequency of Formal Triage Use (Q15)

Response Category	Freq	%
Always	4	4
Sometimes	46	46
Rarely	38	38
Never	12	12

4.5.2 Triage Methods Used

Respondents were able to select multiple triage approaches. The most commonly used method was clinical judgement based on severity, reported by 88% of respondents.

A non-structured method approach was used by 67%, indicating reliance on informal or ad-hoc decision-making in many clinics.

A colour-coded triage system was used by only 16%, reflecting very limited adoption of formalised emergency classification frameworks.

Formal triage tools or structured protocols were used by only 4% of clinics.

These results indicate that triage practices in most clinics are informal and clinician-dependent, with minimal utilisation of structured systems.

Table 4.5.2. Triage Methods Used (Multiple Response Analysis)

Triage Method	n	%
Clinical judgement based on severity	88	88
No structured method	67	67
Colour-coded triage system	16	16
Formal/structured triage protocol	4	4

4.5.3 Baseline Triage Knowledge

Triage knowledge was assessed by asking respondents to identify the most life-threatening condition from four options. A total of 65% correctly selected *dyspnea*, while 33% incorrectly selected *seizure*, and 2% selected *limping*. No respondents (0%) chose diarrhoea as the most life-threatening condition.

Although most participants recognised dyspnea as a critical emergency, the substantial proportion selecting seizure indicates variability in emergency recognition, highlighting the need for structured triage training or decision-support tools.

Table 4.5.3. Identification of a Life-Threatening Condition

Condition Selected	n	%

Dyspnea (Correct)	65	65
Limping	21	21
Seizure	14	14
Diarrhoea	0	0

4.6 Pre-Intervention Knowledge

Pre-intervention knowledge was assessed using two multiple-choice questions evaluating recognition of life-threatening conditions (Q17) and appropriate first actions in a suspected emergency scenario (Q18). These questions were designed to establish baseline emergency decision-making ability before exposure to the intervention.

4.6.1 Recognition of a Life-Threatening Condition

When asked to identify the most life-threatening clinical presentation from four options, 65% of respondents correctly selected *dyspnea*. Meanwhile, 33% incorrectly selected *'seizure', 2% selected 'limping', and none (0%) selected 'diarrhoea'*.

Although the majority recognised dyspnea as the highest-priority emergency, a substantial proportion chose seizure, which indicates an inconsistent understanding of emergency severity grading. This highlights variability in baseline triage knowledge across clinics.

Table 4.6.1. Pre-Intervention Recognition of a Life-Threatening Condition

Condition Selected	**n**	**%**

Dyspnea (Correct)	65	65
Limping	21	21
Seizure	14	14
Diarrhoea	0	0

4.6.2 First Action in a Suspected Emergency Scenario

Participants were also assessed on their ability to select the correct initial action when presented with a suspected emergency case (e.g., gastric dilatation-volvulus). The majority of respondents (46%) selected '*take radiographs'*, which is not the recommended first action. Only 35% selected the correct choice, *administer intravenous fluids*. Among paraprofessionals, 17% selected '*call the veterinarian in charge'*, which is considered an appropriate response for their role. A small proportion (2%) selected '*prepare for surgery'*.

These findings demonstrate gaps in baseline emergency management knowledge, particularly surrounding the importance of early stabilisation before diagnostics.

Table 4.6.2. Pre-Intervention Emergency Management Decision

Response Option	**n**	**%**
Administer IV fluids (Correct)	35	35

Call the veterinarian in charge*	17	17
Prepare for surgery	2	2
Take radiographs	46	46

*Appropriate for paraprofessionals.

4.7 Pre-Intervention Confidence

Pre-intervention confidence was assessed using six Likert-type items, with one item measuring respondents' confidence in identifying emergency conditions (Q19) and five items measuring confidence in managing specific emergency scenarios (Q20–Q24). These items were evaluated to establish baseline confidence prior to the educational intervention.

Normality testing using the Kolmogorov–Smirnov and Shapiro–Wilk tests indicated that all confidence items were non-normally distributed ($p < 0.001$), justifying the use of non-parametric tests for later comparisons.

4.7.1 Confidence in Identifying Emergency Conditions

Respondents demonstrated relatively low baseline confidence in identifying emergency conditions, with a mean score of 1.21 ± 0.518, a median of 1.00, and an interquartile range (IQR) of 1. Scores ranged from 0 to 2, indicating that most respondents fell between "not confident" and "slightly confident." This suggests that many participants were unsure of their ability to consistently recognise emergency presentations without additional support or training.

Table 4.7.1. Pre-Intervention Confidence in Identifying Emergency Conditions

Statistic	Value
Mean	1.21
Standard deviation	0.518
Median	1
Minimum	0
Maximum	2
Interquartile range	1

4.7.2 Confidence in Managing Emergency Conditions

Respondents showed moderate baseline confidence across the five emergency domains assessed. Confidence was highest for managing respiratory distress (Mean = 3.78, SD = 0.596) and haemorrhage (Mean = 3.76, SD = 0.638). Lower confidence was reported for managing cardiopulmonary arrest (CPA) (Mean = 3.58, SD = 0.684) and polytrauma (Mean = 3.58, SD = 0.654). Median scores were 4 across all items, indicating that most respondents felt "confident," though substantial variability remained.

These findings reflect typical clinical exposure patterns, as high-acuity emergencies such as CPA and polytrauma are less frequent and more technically demanding.

Table 4.8.2. Pre-Intervention Confidence in Managing Emergency Conditions

Emergency Domain	Mean	SD	Median	IQR
Respiratory distress	3.78	0.596	4	1
Seizures	3.65	0.757	4	1
Cardiopulmonary arrest (CPA)	3.58	0.684	4	1
Polytrauma	3.58	0.654	4	1
Haemorrhage	3.76	0.638	4	1

4.7.3 Summary of Pre-Intervention Confidence

Overall, participants demonstrated moderate confidence in managing emergency situations but relatively low confidence in their ability to identify emergencies. This suggests that while respondents may feel capable of performing emergency interventions, they may be less certain about recognising when a situation constitutes an emergency—an important prerequisite for timely triage and intervention.

4.8 Post-Intervention Confidence

Following the use of the veterinary emergency mobile application, respondents completed the same six confidence items to assess changes in their perceived ability to identify and manage emergency situations. As with pre-intervention scores, all post-intervention items violated the

assumption of normality (Kolmogorov–Smirnov and Shapiro–Wilk tests, $p < 0.001$), supporting the use of non-parametric Wilcoxon Signed-Rank Tests for pre–post comparison.

Overall, post-intervention confidence scores increased across all domains, demonstrating the positive effect of the mobile application on clinicians' perceived emergency readiness.

4.8.1 Confidence in Identifying Emergency Conditions

Table 4.8.1. Post-Intervention Confidence in Identifying Emergency Conditions

Statistic	Value
Mean	1.47
Standard deviation	0.502
Median	1
Minimum	1
Maximum	2
Interquartile range	1

4.8.2 Confidence in Managing Emergency Conditions

Respondents also demonstrated clear improvements in confidence across all emergency management domains. Mean post-intervention scores ranged from 4.20 to 4.33, with all items showing higher values compared to pre-intervention levels.

Median scores remained at 4.00, but variability decreased, indicating more consistent confidence across respondents after using the application.

Table 4.8.2. Post-Intervention Confidence in Managing Emergency Conditions

Emergency Domain	Mean	SD	Median	IQR
Respiratory distress	4.25	0.52	4	1
Seizures	4.2	0.532	4	1
Cardiopulmonary arrest (CPA)	4.3	0.56	4	1
Polytrauma	4.33	0.551	4	1
Haemorrhage	4.33	0.514	4	1

4.8.3 Summary of Post-Intervention Confidence

Post-intervention confidence improved across all domains, demonstrating a consistent positive effect of the mobile application. Respondents reported higher confidence in identifying emergencies and managing respiratory distress, seizures, CPA, polytrauma, and haemorrhage. The reduction in variability across responses suggests the intervention contributed to more uniform emergency preparedness among participants.

4.9 Post-Intervention Knowledge

Post-intervention knowledge was assessed using the same two multiple-choice questions as in the pre-intervention phase to evaluate improvements in emergency recognition and initial stabilisation decision-making.

4.9.1 Recognition of a Life-Threatening Condition

After the intervention, 99% of respondents correctly identified *dyspnea* as the most life-threatening condition, a substantial increase from the pre-intervention correct rate of 65%. Only 1% selected *seizure*, and no respondents selected *limping* or *diarrhoea*.

This marked improvement demonstrates the effectiveness of the intervention in reinforcing accurate emergency prioritisation.

Table 4.9.1. Post-Intervention Recognition of a Life-Threatening Condition (Q39)

Condition Selected	n	%
Dyspnea (Correct)	99	99
Seizure	1	1
Limping	0	0
Diarrhoea	0	0

4.9.2 First Action in a Suspected Emergency Scenario

Post-intervention, 91% of respondents correctly selected '*administer IV fluids'* as the appropriate first action in a suspected emergency scenario such as GDV. This reflects a great improvement from the pre-intervention correct rate of 35%.

Incorrect responses decreased substantially: 6% selected '*call the veterinarian in charge'* (appropriate for paraprofessionals), and 3% selected '*take radiographs'*. No respondents selected '*prepare for surgery'*.

These results indicate that the intervention significantly enhanced respondents' understanding of proper emergency stabilisation protocols.

Table 4.9.2. Post-Intervention Emergency Management Decision

Response Option	n	%
Administer IV fluids (Correct)	91	91
Call the veterinarian in charge*	6	6
Take radiographs	3	3
Prepare for surgery	0	0

*Appropriate answer for paraprofessionals.

4.10 Effect of Intervention

The intervention's impact on emergency preparedness was evaluated across two domains: knowledge improvement and confidence enhancement. As all confidence items violated normality

assumptions (Section 4.8), the Wilcoxon Signed-Rank Test was used to analyse pre–post differences. Knowledge items were categorical and were analysed using the McNemar Test.

4.10.1 Effect on Emergency Knowledge (McNemar Test)

(a) Identification of the Life-Threatening Condition

Correct identification of dyspnea as the most life-threatening condition increased from 65% pre-intervention to 99% post-intervention.

Table 4.10.1 (a1) Crosstabulation for Life-Threatening Condition (Pre vs. Post)

Count		Post-intervention		
		Incorrect	Correct	Total
Pre-intervention	Incorrect	1	34	35
	Correct	0	65	65
Total		1	99	100

Table 4.10.1 (a2) McNemar Test for Life-Threatening Condition (Pre vs. Post)

Chi-Square Tests		
	Value	Exact Sig. (2-sided)
McNemar Test		<.000[a]
N of Valid Cases	100	

a. Binomial distribution used.

McNemar's test showed a significant improvement (Exact p < .001). Thirty-four participants shifted from incorrect to correct, and none declined.

(b) Correct First Action in a Suspected GDV case

Correct responses increased from 35% pre-intervention to 91% post-intervention.

Table 4.10.1 (b1) Crosstabulation for Correct First Action in GDV (Pre vs. Post)

Count				
		Post-intervention		
		Incorrect	Correct	Total
Pre-intervention	Incorrect	3	45	48
	Correct	0	52	52
Total		3	97	100

Table 4.10.1 (b2) McNemar Test for Correct First Action in GDV (Pre vs. Post)

Chi-Square Tests

	Value	Exact Sig. (2-sided)
McNemar Test		<.000[a]
N of Valid Cases	100	

a. Binomial distribution used.

McNemar's test again indicated a significant positive shift (Exact $p < .001$). Forty-five respondents improved, with none declining.

4.10.2 Effect on Emergency Confidence

Confidence outcomes were separated into:

- Confidence in identifying emergencies (Q19)
- Confidence in managing emergency conditions (Q20–Q24)

This separation reflects the conceptual difference between recognising an emergency and performing clinical interventions.

4.10.2.1 Confidence in Identifying Emergency Conditions

Confidence increased significantly after the intervention.

Table 4.10.2.1 (a) Wilcoxon Signed-Rank Test for Confidence in Identifying Emergency Condition

Post–Pre Comparison	N	Mean Rank	Sum of Ranks
Negative Ranks (Post < Pre)	0	0	0
Positive Ranks (Post > Pre)	26	13.5	351
Ties (Post = Pre)	74	—	—
Total	100		

Table 4.10.2.1 (b) Wilcoxon Signed-Rank Test Statistics for Confidence in Identifying Emergency Condition

Test	Value
Z	-5.099
Asymp. Sig. (2-tailed)	< .001

Effect size:

$r = Z/\sqrt{N}$

r = -5.099/ 10

r = 0.510 (Large)

A significant improvement was observed (Z = -5.099, p < .001), with a **large effect size**, indicating meaningful gains in participants' ability to recognise emergency presentations.

4.10.2.2 Confidence in Emergency Management Confidence

Confidence increased significantly after the intervention.

Table 4.10.2.2 (a) Wilcoxon Signed-Rank Test for Confidence in Handling Emergency Condition

Emergency Domain				
Respiratory Distress	**Post–Pre Comparison**	**N**	**Mean Rank**	**Sum of Ranks**
	Negative Ranks (Post < Pre)	1	24	24
	Positive Ranks (Post > Pre)	47	24.51	1152
	Ties (Post = Pre)	52	—	—

	Total	100		

Seizures	Post–Pre Comparison	N	Mean Rank	Sum of Ranks
	Negative Ranks (Post < Pre)	3	26	78
	Positive Ranks (Post > Pre)	53	28.64	1518
	Ties (Post = Pre)	44	—	—
	Total	100		

Cardiopulmonary Arrest (CPA)	Post–Pre Comparison	N	Mean Rank	Sum of Ranks
	Negative Ranks (Post < Pre)	1	28.5	28.5
	Positive Ranks (Post > Pre)	64	33.07	2116.5
	Ties (Post = Pre)	35	—	—
	Total	100		

Polytrauma	Post–Pre Comparison	N	Mean Rank	Sum of Ranks
	Negative Ranks (Post < Pre)	0	0	0
	Positive Ranks (Post > Pre)	67	34	2278
	Ties (Post = Pre)	33	—	—
	Total	100		

	Post–Pre Comparison	N	Mean Rank	Sum of Ranks
Hemorrhage	Negative Ranks (Post < Pre)	0	0	0
	Positive Ranks (Post > Pre)	53	27	1431
	Ties (Post = Pre)	47	—	—
	Total	100		
Total Handling Emergency Confidence Score	**Post–Pre Comparison**	**N**	**Mean Rank**	**Sum of Ranks**
	Negative Ranks (Post < Pre)	2	7	14
	Positive Ranks (Post > Pre)	92	48.38	4451
	Ties (Post = Pre)	6	—	—
	Total	100		

Table 4.10.2.2 (b) Wilcoxon Signed-Rank Test Statistics for Emergency Management Confidence

Emergency Domain	Z-value	Asymp. Sig. (2-tailed)
Respiratory distress	-6.581	< .001
Seizure management	-6.502	< .001
Cardiopulmonary arrest (CPA)	-7.43	< .001
Polytrauma management	-7.797	< .001
Hemorrhage management	-7.047	< .001
Total emergency confidence score	-8.405	< .001

Table 4.10.2.2 (c). Effect Sizes (r) for Wilcoxon Signed-Rank Tests on Emergency Confidence

Emergency Domain	Z-value	Effect Size (r = Z/10)	Interpretation
Respiratory distress	-6.581	0.658	Large
Seizure management	-6.502	0.65	Large
Cardiopulmonary arrest (CPA)	-7.43	0.743	Large
Polytrauma management	-7.797	0.78	Large
Hemorrhage management	-7.047	0.705	Large

Total emergency confidence score	-8.405	0.841	Very large

All domains demonstrated significant improvements, with the strongest effects observed in polytrauma and CPA, which typically represent the most complex emergencies. The very large effect size for total confidence (r = 0.841) demonstrates that the intervention substantially improved overall emergency confidence.

4.10.3 Overall Effect of the Intervention

Significant improvements were observed across both emergency knowledge and confidence. Knowledge gains were substantial, with nearly all participants correctly identifying life-threatening emergencies and selecting appropriate stabilisation actions after the intervention. Confidence improved across all domains, with effect sizes consistently in the large or very large range, indicating a strong practical impact.

In summary, the mobile application was highly effective in improving both emergency knowledge and confidence, reinforcing its value as an educational and clinical decision-support tool for veterinary practitioners.

4.11 System Usability Scale (SUS)

The usability of the mobile application was assessed using the 10-item System Usability Scale (SUS). SUS scores range from 0 to 100, with higher scores indicating better perceived usability. Descriptive statistics for the total SUS score are presented in Table 5.

4.12.1 SUS Descriptive Statistics

Table 4.12.1 Descriptive Statistics for System Usability Scale (N = 100)

Statistic	Value
Mean SUS score	85.65
Standard deviation	7.32
Median	85
Minimum	50
Maximum	100
Range	50
95% CI (Lower–Upper)	84.20 – 87.10
Interquartile range	7.5
Skewness	-1.015
Kurtosis	4.749

The mean SUS score of 85.65 ± 7.32 indicates that participants perceived the application as highly usable. The distribution was negatively skewed, suggesting a clustering of high usability ratings.

4.12.3 SUS Score Interpretation

Based on the established interpretation guidelines by Bangor, Kortum, and Miller (2009) and Sauro (2011), the mean SUS score of 85.65 indicates that the mobile application falls within the "Excellent" usability category. SUS scores above 85 consistently correspond to an A-grade

usability rating, placing the application within the top percentile range of comparable digital tools. Systems achieving scores in this band are generally regarded as highly effective, intuitive, and easy to use, requiring minimal effort from users to learn or navigate the interface. The high SUS score, therefore, suggests that participants perceived the application as well-designed, user-friendly, and appropriate for integration into routine clinical workflows. In combination with the narrow confidence interval and low variability in scores, these results indicate consistent positive user experience, reinforcing the application's suitability as a practical tool to support emergency preparedness and triage decision-making in veterinary practice.

4.12.4 Summary of SUS Findings

Overall, the SUS results demonstrate that the application achieved high usability, with ratings consistently within the "Excellent" category. The high mean score and narrow confidence interval suggest that users found the design intuitive and efficient. Combined with the significant improvements in knowledge and confidence (Section 4.11), these findings indicate that the mobile application is both effective and user-friendly.

CHAPTER 5

5.0 DISCUSSION

This study evaluated emergency preparedness, triage practices, emergency knowledge, confidence, and the usability of a newly developed mobile application among veterinary professionals in Malaysia. The discussion is organised to address each study objective and to interpret the findings in the context of existing veterinary and medical emergency preparedness literature.

5.1 Emergency Preparedness in Veterinary Clinics

The overall emergency preparedness score indicated moderate preparedness among participating clinics, with a mean weighted score of 34.71 out of 50. When categorised using Bloom's cut-off points, 79% of respondents fell into the moderately prepared category, while only 11% demonstrated good preparedness. This aligns with international findings showing that emergency readiness varies considerably within general veterinary practice, particularly in small-animal clinics that do not consistently manage high-acuity emergencies. Similar patterns have been reported in studies examining preparedness in both veterinary and human healthcare systems, where organisational-level preparedness frequently lags behind individual clinician capability.

Despite the adequate availability of crash kits, power backup systems, and basic emergency supplies, several critical elements were lacking. Emergency drills were rarely conducted, with only 2% of participants reporting regular practice. Studies in human medicine demonstrate that simulation drills significantly enhance response coordination, reduce errors, and improve overall emergency performance; thus, the infrequency of drills in veterinary settings highlights a key area for improvement.

Furthermore, essential monitoring equipment, such as capnography, was notably underutilised, available in only 7% of surveyed clinics. This finding is consistent with previous research showing slow adoption of capnography in veterinary practice despite established evidence

of its importance in cardiopulmonary resuscitation, anaesthesia safety, and respiratory monitoring. Potential barriers include cost, limited training, or uncertainty about its clinical value.

Perceived preparedness was moderately high (mean = 3.81), suggesting potential overestimation of readiness, a trend commonly noted in the literature where subjective preparedness ratings tend to exceed objective indicators. This disparity highlights the importance of structured assessment tools in providing an accurate reflection of emergency readiness.

5.2 Triage Practices Among Veterinary Personnel

Triage practices varied significantly among respondents. Most relied on clinical judgement alone or informal approaches, while only a minority used structured, colour-coded triage systems. Although a majority correctly identified dyspnea and seizures as life-threatening conditions, the inconsistent application of formal triage systems indicates a gap in standardisation.

This variability mirrors findings from veterinary studies in other countries, including Australia, the United Kingdom, and the United States, where structured triage frameworks such as the Veterinary Triage List (VTL) or modified human triage scales exist but are underutilised in routine practice. Potential contributing factors include insufficient training, time constraints, or a lack of clinic policies mandating triage documentation.

These findings emphasise the need for accessible and standardised triage tools to support rapid decision-making, prioritisation, and patient outcomes—reinforcing the relevance of the mobile application developed in this study.

5.3 Impact of the Intervention on Emergency Knowledge

The intervention produced statistically significant improvements in emergency knowledge. Correct identification of the most life-threatening condition increased from 65% pre-intervention

to 99% post-intervention (McNemar $p < .001$), and correct first actions for a suspected GDV increased from 35% to 91% ($p < .001$).

These improvements align with studies demonstrating the effectiveness of mobile learning and digital decision-support tools in enhancing recognition of critical emergencies in both veterinary and human healthcare environments. Digital interventions reduce cognitive load, provide rapid reference information, and reinforce learning through repeated exposure. The substantial shift from incorrect to correct responses indicates that the mobile application was successful in delivering accurate and easily retrievable emergency guidance.

5.4 Impact of the Intervention on Emergency Confidence

Confidence levels increased significantly across all assessed domains. Confidence in identifying emergency conditions (Q19) improved with a large effect size ($r = 0.510$), while confidence in managing specific emergency scenarios (respiratory distress, seizures, cardiopulmonary arrest, polytrauma, and haemorrhage) showed large to very large effect sizes ($r = 0.650–0.841$). The most pronounced improvements were noted for cardiopulmonary arrest and polytrauma, areas associated with high clinical difficulty and uncertainty.

These findings are consistent with the literature, which demonstrates that structured algorithms, mobile decision-support tools, and visual aids improve clinician confidence, particularly in high-stress emergency conditions. The large effect sizes observed in this study confirm that the intervention had not only statistical significance but also a substantial practical impact on clinicians' confidence and perceived competence.

5.5 Usability and Acceptance of the Mobile Application

The application achieved a mean SUS score of 85.65, placing it within the "Excellent" usability category and corresponding to an A-grade usability. According to Bangor et al. (2009),

SUS scores above 85 indicate highly intuitive, user-friendly systems with a strong likelihood of acceptance.

The negatively skewed distribution of SUS scores suggests that most respondents rated usability highly, with few respondents giving low ratings. Combined with the demonstrated improvements in knowledge and confidence, this suggests that the mobile application is both effective and highly acceptable as a clinical support tool. Comparable digital health studies report similar outcomes when tools are designed for rapid access, minimal cognitive effort, and practical relevance to clinical workflows.

5.6 Implications for Veterinary Emergency Practice

The findings of this study highlight the need for greater standardisation in veterinary emergency practices. Variability in emergency response approaches across clinics suggests that the absence of structured triage systems and written emergency protocols may contribute to inconsistent clinical decision-making. The implementation of standardised triage frameworks and clearly defined emergency guidelines would help promote uniformity in patient assessment and prioritisation, ultimately improving the timeliness and quality of emergency care.

Additionally, the low frequency of emergency drills and the limited use of critical patient monitoring equipment highlight gaps in training and preparedness within veterinary practices. These deficiencies indicate a need for more structured continuing professional development initiatives and clinic-level policies that emphasise emergency preparedness, regular simulation exercises, and the appropriate utilisation of essential monitoring tools during critical cases.

The significant improvements observed in participants' knowledge and confidence following the intervention, alongside high usability scores, demonstrate the effectiveness of digital tools in strengthening veterinary emergency readiness. Mobile applications offer an efficient, accessible, and user-friendly platform for delivering emergency guidance and educational content, particularly in fast-paced clinical environments where rapid decision-making is essential.

Finally, given the diversity of veterinary practice settings across Malaysia, the mobile application developed in this study presents strong potential for national scalability. Its adaptable design allows for integration into routine clinical workflows, undergraduate veterinary training, and continuing professional development programmes, supporting broader efforts to improve emergency preparedness and triage practices at a national level.

5.7 Strengths and Limitations

5.7.1 Strengths

- This is the first known study in Malaysia to comprehensively assess emergency preparedness, triage practices, emergency knowledge, confidence, and usability among veterinary professionals.

- The use of objective measures (e.g., McNemar test, weighted preparedness scoring) and subjective measures (confidence ratings, SUS) provides a multidimensional evaluation of emergency readiness.

- The intervention design enabled immediate pre–post comparison, minimising recall bias.

- Participation from varied clinic types and professional roles improves practical relevance.

5.7.2 Limitations

Several limitations should be considered.

Firstly, the study employed a pre–post design without a control group, which limits causal inference. While improvements were substantial, alternative explanations such as exposure to external resources or participant motivation cannot be entirely excluded. A randomised controlled design would strengthen future evaluations.

Secondly, purposive sampling was employed to target veterinary professionals directly. This sampling approach, while practical, may introduce selection bias, as individuals or clinics more

interested in emergency preparedness may have been more likely to participate. Consequently, the results may slightly overestimate preparedness or app usability.

Thirdly, the study relied partly on self-reported data, which may be subject to response bias or social desirability effects. As seen in previous literature, perceived preparedness often exceeds actual preparedness, which may explain the disparity observed in this study.

Fourth, the study evaluated only immediate post-intervention outcomes, and long-term retention of knowledge and confidence was not assessed. Emergency management skills may deteriorate without reinforcement; therefore, future longitudinal studies are recommended.

Finally, differences between clinics—such as caseload, staffing, equipment availability, and operating procedures—may influence emergency readiness but were not controlled for. These contextual factors merit exploration in future research.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study provides the first comprehensive evaluation of emergency preparedness, triage practices, emergency knowledge, confidence, and mobile application usability among veterinary professionals in Malaysia. Findings indicate that overall emergency preparedness across clinics is moderate, with substantial variability in the availability of emergency equipment, written protocols, and simulation-based training. While most clinics possess essential supplies and crash kits, critical monitoring tools such as capnography and structured emergency drills are notably lacking.

Triage practices were found to be inconsistent, with most respondents relying on clinical judgement rather than formal triage systems. This highlights a significant opportunity to standardise emergency triage across Malaysian veterinary practices.

The mobile application developed for this study demonstrated strong effectiveness. Emergency knowledge improved significantly, with substantial increases in the correct identification of life-threatening conditions and appropriate first actions for GDV. Confidence also improved markedly across all emergency domains, with large to very large effect sizes, indicating both statistical and practical significance. The application was rated as highly usable, achieving a SUS score of 85.65, which places it in the “Excellent” category.

Overall, this study demonstrates that the mobile application is an effective, accessible, and user-friendly tool that can strengthen veterinary emergency preparedness and triage decision-making nationwide. These findings support its integration into daily clinical practice, continuing education, and undergraduate veterinary training.

6.2 Recommendations

6.2.1 Recommendations for Veterinary Clinics

1. **Implement structured triage systems**
   Clinics should adopt standardised, colour-coded triage frameworks to improve consistency, prioritisation, and clinical outcomes.

2. **Develop written emergency protocols**
   Formal emergency SOPs can guide staff responses, reduce variability, and strengthen preparedness.

3. **Increase frequency of emergency drills**
   Simulation training should be conducted regularly to enhance team coordination and reduce response times in real emergencies.

4. **Invest in essential emergency monitoring equipment**
   Greater adoption of capnography, ECG, and blood pressure monitoring will improve case management and safety.

6.2.2 Recommendations for Veterinary Education and Training

1. **Integrate emergency preparedness modules into veterinary curricula**
   Undergraduate students should receive structured exposure to triage systems, emergency protocols, and simulation-based learning.

2. **Provide continuing professional development (CPD) workshops**
   Hands-on emergency courses and digital learning tools can help maintain proficiency among practitioners.

3. **Promote the use of decision-support applications**
   Mobile tools like the one developed in this study can support real-time decision-making

and reinforce training.

6.2.3 Recommendations for Future Research

1. **Adopt controlled or randomised study designs**
   Future studies should include control groups to strengthen causal conclusions about the effectiveness of interventions.

2. **Use random or stratified sampling**
   Broader sampling methods would increase generalisability across Malaysia's veterinary sector.

3. **Assess long-term retention**
   Follow-up assessments over several months would help determine whether the gains in knowledge and confidence are sustained.

4. **Explore clinic-level variables**
   Research should investigate how factors such as clinic size, staffing, equipment availability, and caseload volume impact emergency readiness.

6.3 Final Statement

The findings of this study highlight both the challenges and opportunities in strengthening veterinary emergency preparedness in Malaysia. While gaps remain in triage systems, training, and equipment availability, the demonstrated effectiveness of the mobile application offers a practical and scalable solution to address these needs. This study, therefore, contributes valuable evidence to support digital innovation in veterinary emergency practice, ultimately improving patient outcomes and clinical confidence.

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APPENDIX

8.1 Appendix 1: Google Survey Questionnaire

Emergency Preparedness and Triage Practices in Veterinary Clinics (Malaysia)

This questionnaire is part of a final year veterinary research project on emergency preparedness and triage practices among veterinary professionals in Malaysia.

This study has been reviewed and approved by the **Institutional Human Care and Use Committee (IHCUC), Universiti Malaysia Kelantan**, under approval code: **UMK/FPV/HUMAN/EXT/0007/2025**.

By participating, you agree to:

1. Complete the **pre-intervention section** of this questionnaire.
2. Download and try the veterinary emergency mobile application (APK file) provided. The app is **safe to use and does not contain any malware**.
3. **Not share the app** with anyone outside your clinic or with individuals who are not veterinary personnel participating in this study as it is strictly for research purposes only.
4. Complete the **post-intervention section** of this questionnaire after using the app, including providing feedback on usability, functionality, and content.

Android Device Requirement

Participation requires the use of an **Android device**, as the app is only compatible with Android.

All information you provide will remain strictly confidential, and no individual participant or clinic will be identified in any report or publication. Participation is voluntary, and you may withdraw at any time without penalty.

If you have any questions regarding this study, you may contact Shakila at: d21b0137@siswa.umk.edu.my

By proceeding, you confirm that you understand the purpose of the study and agree to participate.

* Indicates required question

1. Do you consent to participate in this study? *

Mark only one oval.

- ◯ Yes
- ◯ No

Pre-Intervention Survey

Section 1: Demographics

2. **Profession** *

Mark only one oval.

- ◯ Veterinarian
- ◯ Vet Nurse
- ◯ Vet Technician
- ◯ Vet Assistant
- ◯ Other: _____

3. **Years of experience** *

Mark only one oval.

- ◯ Less than 1 year
- ◯ 1 - 3 years
- ◯ 4 - 7 years
- ◯ More than 7 years

4. **Type of practice** *

Mark only one oval.

- ◯ Private small animal
- ◯ Mixed
- ◯ University hospital
- ◯ Govt/NGO
- ◯ Other: _____

5. **State** * Dropdown

Mark only one oval.

- ◯ W.P. Kuala Lumpur
- ◯ Selangor
- ◯ Johor
- ◯ Kedah
- ◯ Kelantan
- ◯ Melaka
- ◯ Negeri Sembilan
- ◯ Pahang
- ◯ Penang (Pulau Pinang)
- ◯ Perak
- ◯ Perlis
- ◯ Terengganu
- ◯ Putrajaya (Federal Territory)
- ◯ Sabah
- ◯ Sarawak
- ◯ Labuan (Federal Territory)

Section 2 : Emergency Preparedness (Clinic Level)

6. Does your clinic have a **written emergency/disaster protocol or SOP?** *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

7. Is your clinic equipped with an **emergency crash kit?** *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

8. Do you have **emergency power backup** (e.g., generator)? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

9. Do you have **emergency supplies for staff/patients** (food, water, meds)? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

10. Have you ever conducted or participated in **emergency drills or simulations** at your clinic? *

Yes, regularly / Yes, once or rarely / No

Mark only one oval.

- ◯ Yes, regularly
- ◯ Yes, once or rarely
- ◯ No

11. Has your clinic designated a **meeting/assembly point** for staff in emergencies? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

12. Does your clinic have the equipment and capability to perform endotracheal intubation in emergency situations? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

13. Which of the following monitoring devices are available in your clinic? *(Select all that apply)* *

Check all that apply.

- ☐ ECG (Electrocardiography)
- ☐ Capnography (End-tidal CO_2 monitoring)
- ☐ Pulse oximetry (SpO_2)
- ☐ Blood pressure monitoring (Doppler or oscillometric)
- ☐ None of the above
- ☐ Not sure

14. Do you feel your clinic is adequately prepared to handle emergencies? *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

Section 3: Triage Practices (Clinic + Individual)

15. Are emergency cases prioritized using a formal triage system in your clinic? *

Mark only one oval.

- ◯ Always
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

16. Which triage approach is used? *(Select all that apply)* *

Check all that apply.

- ☐ Color-coded triage system (Red, Yellow, Green)
- ☐ Based on severity/clinical judgment
- ☐ No structured method
- ☐ Not sure

17. Which of the following conditions is **most life-threatening**? *

Mark only one oval.

- Seizure
- Dyspnea
- Limping
- Diarrhea

18. In a suspected GDV case, what is the **first action** you would take? *

Mark only one oval.

- Administer IV fluids
- Take radiographs
- Prepare for surgery
- Call the vet in charge (for paraprofessionals)

19. How confident are you in identifying emergency conditions in patients? *

Mark only one oval.

- Very confident
- Somewhat confident
- Not confident

20. On a scale of 1–5, rate your confidence in handling: *

Respiratory distress

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

21. On a scale of 1–5, rate your confidence in handling: *

Seizures

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

22. On a scale of 1–5, rate your confidence in handling: *

Cardiopulmonary arrest

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

23. On a scale of 1–5, rate your confidence in handling: *

Polytrauma

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Not confident

24. On a scale of 1–5, rate your confidence in handling: *

Hemorrhage

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

Section 4: Self-Evaluation & Needs

25. Have you received **formal CPR training (e.g., RECOVER)?** *

Mark only one oval.

- ◯ Yes
- ◯ No

26. What do you think would most improve **emergency preparedness** in your clinic? *

Check all that apply.

- ☐ More training
- ☐ Clear SOPs
- ☐ Better equipment
- ☐ Triage decision tools
- ☐ Other: _____

27. Would you find a **triage reference guide (poster/app)** useful? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

App Download & Compliance Verification

To proceed with this study, please download and try the **Veterinary Emergency Preparedness & Triage App** using the link or scan the QR code below.
⚠ **Important:**

- This prototype app is currently compatible **ONLY with Android devices** (APK format).
- Participants using iOS devices will not be able to install the app.
- This app is a prototype developed solely for academic and research purposes.

✓ **It is safe to use and does not contain any malware.**

✓ The file has been scanned before distribution and is free from harmful software.

After downloading and opening the app, please upload a **screenshot** showing that you have installed or accessed the app. This is required to ensure participant compliance for the study.

If you have any questions or difficulty accessing the app, please contact:

d21b0137@siswa.umk.edu.my

26. Upload your screenshot here: *

Files submitted:

https://drive.google.com/file/d/14Zc6VZvhNz9FOu0fSqYSboXeuaUTzoBU/view?usp=sharing

Post-Intervention Survey

Section 1: App Usability (System Usability Scale – SUS)

29. I think that I would like to use this app frequently. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

30. I found the app unnecessarily complex. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

31. I thought the app was easy to use. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

32. I think that I would need technical support to use this app. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

33. I found the various functions in this app well integrated. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

34. I thought there was too much inconsistency in the app. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

35. I imagine most veterinary personnel would learn to use this app very quickly. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

36. I found the app very troublesome to use. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

37. I felt very confident using the app. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

38. I needed to learn a lot of things before I could get going with this app. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

Section 2 : Individual Preparedness & Growth

39. Which of the following conditions is **most life-threatening**? *

Mark only one oval.

- ◯ Diarrhea
- ◯ Seizure
- ◯ Dyspnea
- ◯ Limping

40. In a suspected GDV case, what is the **first action** you would take? *

Mark only one oval.

- ◯ Prepare for surgery
- ◯ Administer IV fluids
- ◯ Take radiographs
- ◯ Call the vet in charge (for paraprofessionals)

41. How confident are you in identifying emergency conditions in patients *(after using the app)*? *

Mark only one oval.

- ◯ Very confident
- ◯ Somewhat confident
- ◯ Not confident

42. On a scale of 1–5, rate your confidence in handling (after using the app): *

Respiratory distress

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

43. On a scale of 1–5, rate your confidence in handling (after using the app): *

Seizures

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

44. On a scale of 1–5, rate your confidence in handling (after using the app): *

Cardiopulmonary arrest

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

45. On a scale of 1–5, rate your confidence in handling (after using the app): *

Polytrauma

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

46. On a scale of 1–5, rate your confidence in handling (after using the app): *

Hemorrhage

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very confident

47. Compared to before using the app, my overall confidence in handling emergencies is: *

Mark only one oval.

- ◯ Much lower
- ◯ Slightly lower
- ◯ No change
- ◯ Slightly higher
- ◯ Much higher

Section 3 : Perceived Impact of App

48. The app improved my confidence in handling emergency cases. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

49. The triage tool helped me prioritize emergency cases more effectively. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

50. The emergency protocols in the app were useful and practical. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

51. The educational modules and quizzes increased my knowledge. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

52. I would recommend this app to other veterinary clinics. *

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

Section 4 : Open Feedback

53. What specific skills or knowledge did you gain after using the app? *

54. What features did you find most useful in the app? *

55. What challenges did you face while using the app? *

56. What improvements would you suggest for future versions of the app? *

57. Any additional comments?

8.2 Appendix 2: Mobile Application