Epidemiology insights from the field in Cambodia

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Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.

Malen Chan

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Below are (from top left to bottom right) some memories of people, locations, and activities that have made the MAE experience so valuable.

With my benevolent supervisors: Dr. Samantha Colquhoun, Dr. Sowath Ly, Dr. Claude Flamand, and Dr. Erik Karlsson.

With the 2022-2023 MAE cohort, Phnom Penh Rabies Prevention Center and Epidemiology and Public Health Unit, IPC.

Thesis Abstract

In this thesis, I demonstrate how my completed projects meet the required competencies for the Master of Philosophy in Applied Epidemiology (MAE) at the Australian National University. I undertook these projects while based at the Institute Pasteur du Cambodge (IPC) in Phnom Penh, Cambodia.

I conducted a retrospective analysis of rabies post-exposure prophylaxis (PEP) use in response to a social media post about a child's death from rabies due to a cat bite in December 2018; she died in February 2019, which resulted in a surge in demand for rabies vaccination in Cambodia. To inform my study, I conducted a literature review on rabies post-exposure prophylaxis intervention and control. For this analysis, I used data collected by Phnom Penh IPC's Rabies Centre from February 2017 to December 2020 to compare vaccination rates for 132,391 patients, two years before the reported death (the social media post), and uptake in the two years after the death. After sharing the social media post, I found a significant increase in rabies vaccinations, especially among the 1–15 age group. This finding indicates that the use of social media to communicate evidence-based public health measures may be beneficial in Cambodia and should be considered in future programmes and interventions to address rabies (Chapter 2).

For my epidemiological study, I investigated the knowledge, attitudes, and practices of poultry workers in live bird markets in Cambodia in relation to avian influenza viruses (AIVs) to determine the impact of the COVID-19 pandemic in this field. My analysis revealed a significant correlation between poultry workers' awareness of avian influenza and their failure to wear personal protective equipment during poultry-related tasks. These findings indicate that public health activities will be able to concentrate on enhancing control and risk mitigation efforts. Chapter 3 presents the details of this study, including my analysis and findings.

Chapter 4 details an evaluation of the Severe Acute Respiratory Illness (SARI) system at two paediatric hospitals in Cambodia. This system has been in operation since 2014 and is used to facilitate information management, inform the hospital staff of the current epidemiological system, provides data for appropriate evidence-based health planning and prevention activities. I evaluated eight attributes of the SARI surveillance system using data collected from 2014 to 2022. I used the Centers for Disease Control and Prevention (CDC) evaluation attributes to assess the system. There were inconsistencies and missing information in data collection. These results will contribute to the improvement of this system by providing

information to streamline and increase consistency in data collection and reporting for both hospitals.

For my disease outbreak investigation, I joined the Communicable Disease Control Department at the Cambodian Ministry of Health to investigate an outbreak in Pursat province where methanol poisoning was suspected at a funeral. I collected data from a field site and hospitals for analysis and interpretation. This outbreak resulted in the death of a 36-year-old male and the admission of 27 cases to hospital for treatment. While we found no evidence of methanol. However, excessive consumption of rice wine was suspected to have led to the death and hospitalisations. We presented our findings to the Ministry and community. Our findings support continuous alcohol product monitoring and show that health promotion of such dangers is essential to prevent future deaths from similar products. Details of this investigation are presented in Chapter 5.

In Chapter 6 of this thesis, I have outlined my teaching experiences. I presented lessons from the field to my MAE cohort on conducting a Knowledge, Attitudes and Practices survey and also taught on study protocol to the Intermediate level Field Epidemiology Training Program students in Cambodia.

These projects and knowledge illustrate my competence as a field epidemiologist and address the MAE program requirements.

Table of contents

Chapter 1: Master of Applied Epidemiology experience

“What I learned in the Master of Philosophy in Applied Epidemiology program!”

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Abbreviation

ANU	Australian National University
CCDC	Cambodian Communicable Disease Control
FAO	Food and Agriculture Organization
IFETP	Intermediate Field Epidemiology Training Program
IPC	Institut Pasteur du Cambodge
PEP	Post-exposure prophylaxis
SARI	Severe Acute Respiratory Illness
WHO	World Health Organization

1.0 Overview of field placement

My Master of Philosophy in Applied Epidemiology (MAE) field placement was at the Institut Pasteur du Cambodge (IPC), Phnom Penh, Cambodia. Founded in 1953, IPC is a non-profit research institute in Cambodia, currently under the high patronage of the Minister of the Kingdom of Cambodia and under the scientific and technical responsibility of the Pasteur Institute (1). During my 22-month MAE program, I had the opportunity to gain practical experience in field epidemiology and benefit from a wide network of field epidemiologists, including professionals from the Australian National University (ANU), the IPC, and Cambodian Communicable Disease Control (CCDC). Furthermore, I had the privilege of participating in international seminars held in Australia, which proved to be an invaluable opportunity for personal and professional growth at this particular timeframe.

To fulfill the competences outlined by the MAE, I successfully undertook three fundamental projects at IPC, with the remaining one lesson learned from the outbreak disease project at CCDC.

This event highlighted the second time in which IPC took on the responsibility of supervising a field epidemiology scholar in partnership with ANU, welcomed a distinguished academic from Southeast Asian nations as an integral component of the MAE program. The field placement was scheduled to commence on the on 14 February 2022 and concluded on 08 December 2023.

Mr. Srean Chhim was the first ANU MAE scholar who had his field placement here (2019-2021), and he contributed on the public health and other projects. As the second experience with MAE for the IPC, the team has an excellent knowledge of epidemiology and laboratory capabilities related to infectious disease. The scope of the IPC target on laboratory-based research and surveillance of infectious diseases (2). It aims to enhance understanding of infectious disease through partner training, provision of laboratory services, and facilitation of international vaccination programs, it offers a diverse range of immunisation.

Fortunately, my field placement at IPC's Epidemiology and Public Health Unit, I had the privilege of being supervised by:

1. Dr. Sowath Ly, Deputy of IPC and Deputy Head of Epidemiology and Public Health Unit, IPC. His background is medical epidemiologist. He graduated master's degree in Tropical Medicine and International Health in Lao PDR in 2005 and later obtained his

PhD at the Montpellier-2 University France in 2011. He has joined the Epidemiology and Public Health Unit of IPC since 2005. As part of the public health at IPCs Vaccination services during 2017-2019, including three rabies prevention centers; one in Phnom Penh, one in Kampong Cham province and the last one in Battambang province. His research activities focus on topics related to infectious disease in the communities, mainly on dengue, (Avian) influenza and rabies.

2. Dr. Claude Flamand, Head of Epidemiology and Public Health Unit, IPC. He obtained a master's degree in Biomathematics and Biostatistics, a PhD in Epidemiology and Public Health from the University of Paris-Saclay, and a Habilitation to Supervise Research (HDR). He has been working for the past 15 years in the field of surveillance and the study of transmission dynamics of infectious and tropical diseases. After completing the national training program in field epidemiology from 2005 to 2007 at the French Public Health Agency and the French School of Public Health, he specialised in the fields of infectious disease surveillance and investigation of health emergencies in tropical environments and spent six additional years at the French Public Health Agency as the referent epidemiology of the French Guiana Unit. In 2013, he joined the Institut Pasteur in French Guiana as the head of epidemiology unit, where he developed research work aimed at better understanding the transmission dynamics of infectious diseases spreading in the general population. His main research work in this field has also focused on studying the real impact of endemics in communities and on reconstructing the history of transmission dynamics for pathogens not routinely monitored. His multidisciplinary approaches have also allowed his team to study the environmental, climatic, human and behavioural determinants of infectious disease transmission from multiple perspectives (epidemiology, surveillance, biostatistics, modelling, public health policy and scientific popularisation). He is also affiliated to the mathematical modelling of Infectious Diseases Unit of the Institut Pasteur in Paris.

3. Dr. Erik Karlsson, Deputy Head of Virology Unit, IPC. During his doctoral work in the Department of Nutrition at the Gillings School of Global Public Health, University of North Carolina at Chapel Hill, he studied the effect of nutrition, especially diet-induced obesity, on immune responses to viral pathogens. Following completion of his PhD, he began to pursue a research career focused on understanding surveillance, viral evolution, host-pathogen interactions, and immune responses. he began working as a

Postdoctoral Research Associate with Dr. Stacey Schultz-Cherry and collaborators at St Jude Childrens Research Hospital to expand his knowledge of virology, viral pathogenesis, co-infection, immunology (primary and vaccine-induced), and infectious disease surveillance. He became a Staff Scientist in Dr. Schultz-Cherry's laboratory, focusing further on the interaction of nutrition and infectious disease as well as helping to oversee influenza surveillance at the animal-human interface worldwide. At IPC, he is in charge of all ongoing activities related to respiratory viruses, including human seasonal and zoonotic viruses, and the Director of the National Influenza Center and the Regional WHO H5 Reference lab. He is integral in the COVID-19 response in Cambodia and worldwide and serve as the Coordinator for the WHO Global COVID-19 Reference Laboratory in the Virology Unit. He also serves as the Co-PI of the newly developed Sequencing Platform at IPC. His work at IPC focuses on surveillance of endemic and emerging viruses in Cambodia, including developing Early Warning systems against the next pandemic. He also frequently consults for UN organisations (FAO and WHO) and am the founder of a research think-tank named: CANARIES: Consortium of Animal market Networks to Assess Risks of emerging Infectious diseases through Enhanced Surveillance.

My field supervisors convened a meeting after course block 1 to identify three projects for me to undertake during my field placement at IPC. Throughout my work, I actively engaged in research and practical work related to the fields of rabies and avian influenza. I am grateful for the consistent support and guidance provided by my field supervisors, who have encouraged and facilitated my involvement in these specific areas of study. In the past, my involvement focused mostly on fieldwork. Nevertheless, my level of knowledge has significantly increased as a result of my enrollment in the MAE program. These projects have played an integral part in enhancing my understanding and expertise in the field.

1.1 Fulfilment of MAE program requirement

To meet the requirements of the Master of Philosophy in Applied Epidemiology at Australian National University, I completed the following field projects:

- Analysis of a public health dataset: Potential Impact of a social media post in 2019 on rabies post-exposure prophylaxis (PEP) at Institut Pasteur du Cambodge (IPC), Cambodia

- Design and conduct epidemiological study: Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID pandemic among live bird markets, 2022-2023.
- Investigate and acute public Health problem: An outbreak of suspicious rice wine poisoning in Cambodia, 2023.
- Establish a surveillance system: Evaluation of Severe Acute Respiratory Illness (SARI) surveillance system in Children based on two paediatric hospitals, 2014-2022

1.2 Publications

Prospective publications

I contributed as a first author (as indicated in Chapter 2) to the manuscript regarding on Potential Impact of a social media event in 2019 on rabies post-exposure prophylaxis (PEP) at Institut Pasteur du Cambodge (IPC).

In addition, another manuscript related to Avian influenza during the MAE (as described in chapter 3) was on Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID-19 pandemic among live poultry market workers, 2022-2023

Other publications as a contributor:

1. Aerosol exposure of live bird market workers to viable influenza A/H5N1 and A/H9N2 viruses, Cambodia

- Horwood PF, Horm SV, Yann S, Tok S, **Chan M**, Suttie A, Y P, Rith S, Siegers JY, San S, Davun H, Tum S, Ly S, Tarantola A, Dussart P, Karlsson EA. Zoonoses Public Health. 2023 Mar;70(2)

2. Influx of Backyard Farming with Limited Biosecurity Due to the COVID-19 Pandemic Carries an Increased Risk of Zoonotic Spillover in Cambodia

- Hyder S, Sievers BL, Flamand C, TagoPacheco D, **Chan M**, Claes F, Karlsson EA. Microbiol Spectr. 2023 Feb 14;11(1):e0420722.

3. Impact of the switch from four to three intradermal rabies post-exposure prophylaxis sessions in patients bitten by dogs: A cost-consequence analysis from the patients' perspective

- Le Bras A, Zarca K, Peng Y, **Chan M**, Durand-Zaleski I. One Health. 2022 Jun 17;15:100408.

1.3 Oral presentations at scientific conferences

I presented the following oral presentations at three international public health conferences which was entitled “Potential Impact of a social media post in 2019 on rabies post-exposure prophylaxis (PEP) at Institut Pasteur du Cambodge (IPC)”:

- World Epidemiology Day (this is a yearly event across the world and the second time we have hosted an event in Canberra), on Wednesday 7 September 2022 at The John Curtin School of Medical Research, The Australian National University.

- The Australian Public Health Association Communicable Diseases & Immunisation Conference 2023, held from Monday 19 to Wednesday 21 June at the Perth Convention Centre.

- The 13th International Conference on Public Health among the Greater Mekong Subregion Countries 2023 (IPHC GMS13), titled "Enhancing Transdisciplinary Collaboration on Education and Research to tackle priority Public health issues in the new Era" and held in Hue & Hanoi city, Vietnam-July 01-02, 2023.

Communication with a lay audience

The findings of the Rabies analysis project were reduced a short one-page document. Aimed for dissemination to important general population. This information and advocacy piece may be found in Appendix 2.5, Chapter 2.

Teaching and capacity building activities

I conducted the following teaching activities as core program requirements:

- Peer-to peer teaching session: Developing a Study Protocols for Intermediate Field Epidemiology Training Program (IFETP) which in Chapter 6, Appendix 6.1.

- Lessons from the field: Conducting a knowledge, Attitude, and practice (KAP) Survey in Live Bird markets, Cambodia (Chapter 6, Appendix 6.3).

The MAE programme requirements are summarised in the table below.

Table 1. 1. Summary of MAE projects and experiences fulfilling core program requirements

Core competency	Chapter					
	1	2	3	4	5	6
Master of Applied Epidemiology experience	√					
Analyse a public health dataset		√				
Design and conduct an epidemiological study			√			
An evaluation project				√		
Outbreak investigation					√	
Review of scientific literature		√				
Publication		√	√			
Oral presentation at a scientific conference		√				
Communication with a lay audience		√				
Teaching activities						√

To facilitate the completion of scholar projects, the MAE program offered comprehensive training. Among the above-mentioned subjects, certain ones were mandatory and required

successful completion. The compulsory courses have been briefly outlined in the table 1. 2 below.

Table1. 2. List of the required course for MAE

Compulsory course for MAE title	Time	Credit in unit
POPH8914 - Issues in Applied Epidemiology	First semester, 2022	6
POPH8920F - Applied Epidemiology Thesis	First semester, 2022	18
POPH8920F - Applied Epidemiology Thesis	Second Semester	24

1.4 Additional public health activities and experiences

Additionally, making contributions to ongoing initiatives, such as providing assistance to Phnom Penh Rabies Center and Virology Unit. I had a privilege of engaging in various projects as following:

- I managed the Rabies database from three Rabies centers which are in Phnom Penh, Battambang and Kampong Cham provinces.

I supervised the performance of fieldwork activities:

- In May and December 2022: “Surveillance of Influenza in Humans, Swine, and Poultry, Cambodia, 2022-2023”.

- In November 2022: “Knowledge and attitudes towards measles vaccination in families living in the floatig village of Prek Toal 2023”.

- In July 2023: I assist Frida Esther Sparaciari, a PhD candidate at James Cook University, with her research “Enhancing and appling effective communication strategies, reporting, risk mitigation measures, and prevention using Environmental Surveillance at high-risk Live Animal Markets and other interfaces.” for submitting a protocol to National Ethics Committee for Health Research (NECHR) in Cambodia.

Prospective works after MAE

- Assist on the project: Enhancing and applying effective communication strategies, reporting, risk mitigation measures, and prevention using Environmental Surveillance at high-risk Live Animal Markets and other interfaces.

- Data managing on the three Rabies Centers namely Phnom Penh, Battambang and Kampong Cham province Rabies Prevention Centers.

- Manuscripts for MAE:

    - Rabies Post-Exposure Prophylaxis (PEP) in 2019 at Institut Pasteur du Cambodge (IPC), Cambodia: the potential impact of a social media event

    - Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID pandemic among live bird markets, 2022-2023.

Reference

1. Institut Pasteur du Cambodge (IPC) [Internet]. [cited 2023 Aug 29]. Available from: https://www.pasteur-kh.org/

2. Institut Pasteur du Cambodge. 2020 Scientific Report and 2021 Perspectives. Phnom Penh; 2020.

3. Srean C. Applied Epidemiology in Cambodia [master's thesis on the Internet]. Australian National University; 2021 [cited 2022 Jul 12]. Available from: https://openresearch-repository.anu.edu.au/bitstream/1885/248196/1/Final_thesis_16Sep2021.pdf

4. Wheeler S. Field Epidemiology in the Pacific [master's thesis on the Internet]. Australian National University; 2021 [cited 2022 Jul 12]. Available from: https://openresearch-repository.anu.edu.au/bitstream/1885/265404/1/MAE%20Thesis%20%20Field%20Epidemiology%20in%20the%20Pacific_OPEN_No_Ch5.pdf

Chapter 2: Rabies Post-Exposure Prophylaxis (PEP) in 2019 at Institut Pasteur du Cambodge (IPC), Cambodia: the potential impact of a social media event

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Preface

Background

This chapter describes my data analysis project, one of the four core requirements of the Master of Philosophy in Applied Epidemiology (MAE). This project also meets the MAE requirements to undertake a literature review (Appendix 2.6), deliver a conference presentation, and prepare a manuscript for submission to a journal.

Since 2014, I have been involved in rabies-related work at the Institut Pasteur du Cambodge (IPC). I subsequently assisted the rabies team with data management and analysis. My field supervisors provided me with the opportunity to investigate the impact of a social media event on the uptake of rabies post-exposure prophylaxis (PEP) in 2019. I have had several opportunities to share these findings at meetings and conferences in both Australia and Vietnam, as well as internally with the IPC teams.

A summary of this project also meets the competency for a plain language information statement that is accessible to a general audience in the public for community information, i.e., for publishing on Facebook, etc., to provide information to the community in a form they can understand in Appendix 2.5.

The preliminary findings of this study were presented at:

1. World Field Epidemiology Day, Wednesday 7 September 2022, John Curtin School of Medical Research, Australian National University (ANU) (Appendix 2.1).

2. Australian Public Health Association Communicable Diseases & Immunisation Conference 2023, 19 to 21 June, Convention Centre, Perth Western Australia (Appendix 2.2).

3. The 13th International Conference on Public Health among the Greater Mekong Subregion Countries 2023 (IPHC GMS13), "Enhancing Transdisciplinary Collaboration on Education and Research to tackle priority Public health issues in the new Era", 1-2 July 2 023, Hue and Hanoi City, Vietnam (Appendix 2.2).

My Role

This project required me to coordinate data collection, clean data, design the project protocol for submission to the Australian National University (ANU) ethics committee, conduct data analysis, descriptively analyse and interpret data, and draft the report for a lay audience (the public) and for an IPC presentation following peer review.

Lessons Learned

This project was beneficial to advance my knowledge of data interpretation and enhance my skills in data analysis. Additionally, it provided a valuable opportunity to identify areas for data strengthening and to ensure high quality in terms of accuracy, completeness, and consistency. Using database queries, I identified and removed duplicate records to prevent data duplication. I examined missing or obviously incorrect information to verify the precision, completeness, and consistency of the data. This entailed cross-referencing with external sources or applying data validation rules, such as the date of consultation and injection. We rigorously tested and verified the data after cleaning the database to ensure its quality and completeness. To verify the accuracy and validity of the cleaned database, I ran example queries and performed data quality checks. I learned how to perform spatial and temporal analysis by using the Quantum Geographic Information System (QGIS) and Stata programs. I reviewed QGIS lessons and acquired useful skills from the Lessons from the Field (LFF) with my classmates, as well as attending a GIS session in MAE course block 3 at the Australian National University. For applied epidemiologists, spatial analysis is a crucial skill. Both STATA and QGIS have immense benefits. I was absolutely delighted when I achieved this competence. Finally, I put my existing insights into practice by tackling these specific components.

Public Health Impact

This study summarises information about PEP patients who sought care at the PEP Center in Phnom Penh, Cambodia, over a four-year period. The results will inform Rabies program perspectives, including intervention design, planning, and priority setting in relation to communication and distribution via social media. Moreover, the spatial analysis provided insights into the population of people involved in bite accidents with animals, which will also aid in the prioritisation of resource distribution to the areas where the patient originates from.

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I would like to extend my heartfelt appreciation to Dr. Samantha Colquhoun, Dr. Sowath Ly, Dr. Claude Flamand, and Dr. Erik Karlsson, who taught me how to write a scientific report. They invested considerable time and effort to read and provide constructive feedback throughout the report's development. Particularly, I would like to thank Dr. Claude for tutoring me in statistical analysis.

Abstract

Background

Rabies remains a major public health challenge in Cambodia, despite being a vaccine-preventable disease by pre- or post-exposure prophylaxis (PrEP or PEP). In February 2019, a ten-year-old girl succumbed to suspected rabies due to a cat bite injury. Her father shared a video of her symptom manifestations on Facebook prior to her death. The use of social media (especially Facebook) is highly popular in Cambodia, and the video led to panic in the community. As a result, thousands of people sought rabies PEP at the Rabies Prevention Centre of the Institut Pasteur du Cambodge (IPC) in the capital city of Phnom Penh. Given that social factors can influence health-seeking behaviour, this analysis aimed to describe how this social media event impacted rabies PEP-seeking behaviour observed at IPC.

Methods

We analysed IPC’s data from the Rabies Prevention Center in Phnom Penh for the period between February 2017 and December 2020. We utilised a retrospective search through social media and news postings for 2019 to capture relevant messages shared by the public. We described and compared PEP data from two years prior and two years after the social media

event following the child's death to identify possible associations between the rabies PEP seeking behaviour and awareness.

Results

During the study period, 132,391 patients received PEP: 48,623 in the two-year period prior to the social media event and 83,768 in the two years following the event, a 63.3% increase. The increase in PEP administrations after the social media posting ranged from 45% to 292%, depending on the individual's home province. Significantly increased risk ratios (RR) for accessing PEP after the social media post were cat bites (RR=1.5; 95%CI=1.4-1.5; P<0.001), bite injuries involving an animal scratch (RR=1.6; 95%CI=1.6-1.6; P<0.001), and injuries by stray animals (RR=1.6; 95%CI=1.6-1.6; P<0.001).

Conclusion

Social media had a significant impact on rabies health-seeking behaviour, particularly following a cat bite incident, as the original event was distributed via Facebook. Monitoring and mitigating social media were difficult, although using social media to communicate evidence-based public health messages may be beneficial.

Abbreviations

ANU	Australian National University
CRF	Case Report Form
DFAT	Direct Fluorescent Antibody Test
HREC	Human Research Ethics Committee
ID	Intradermal
IM	Intramuscular
IPC	Institut Pasteur du Cambodge
LFF	Lessons from the Field
MAE	Master of Philosophy in Applied Epidemiology
NCEPH	National Centre for Epidemiology and Population Health
NEHCR	National Ethic Committee for Health Research
PEP	Post-Exposure Prophylaxis
PrEP	Pre-Exposure Prophylaxis
QGIS	Quantum Geographic Information System
RR	Relative Risk
RIG	Rabies Immune Globulin
WHO	World Health Organization

2.0 Introduction

Rabies

Rabies, with its 100% fatality rate, presents a significant public health concern, especially in regions where it is endemic. Rabies virus is a member of the Rhabdoviridae family and Lyssavirus genus (1). Rabies is the most serious threat to public health from animal bite injuries (2,3). As the disease develops, the individual may develop confusion, abnormal behaviours, hallucinations, hydrophobia (fear of water), and insomnia. Typically, the acute, symptomatic phase of a disease lasts between 2 and 10 days. Once rabies symptoms occur, the disease is 100% fatal (4).

Human rabies virus exposure from bites or even scratch lesions caused by animals such as dogs and cats are a significant concern for public health (5). In rabies-endemic nations, the likelihood of a bite or scratch is extremely high (2). Despite its 100% fatality rate, rabies is completely preventable. Immediate and sufficient rabies post-exposure prophylaxis (PEP) can achieve prevention (7–11). Additionally, it is advisable for those traveling to countries with a high prevalence of rabies, as well as those with a higher risk of exposure (i.e., veterinarians or laboratory personnel), to consider pre-exposure prophylaxis (PrEP) as a preventive measure against rabies infection (12).

Rabies in Cambodia

Cambodia is a rabies-endemic country. Rabies infections cause an estimated 800 human deaths per year, with an average annual incidence of 5.8 per 100,000 people (10). In Cambodia, there are several Rabies Prevention Centers, including three under the Institut Pasteur du Cambodge (IPC), as well as private clinics. However, since 2008, IPC's Phnom Penh Rabies Prevention Center has been the most active center for rabies PEP, averaging more than 20,000 patients per year. The Virology Unit of IPC has been performing laboratory diagnostic testing on animals since 1998, using the Direct Fluorescent Antibody Test (DFAT) on animal brain samples from animal carcasses brought in by patients seeking rabies PEP at IPC. Ly *et al.* (2009) analysed these data from 1998 to 2007 and found that among the 1,214 dog brain samples (97% of all animal samples collected in that period), 610 (49%) were positive for the rabies virus. However, Cambodia's underreporting of human cases poses significant challenges in assessing the disease's impact on the population (12).

In accordance with the global framework for the elimination of dog-mediated human rabies, Cambodia has committed to reaching the objective “zero by 2030” (14). The focus is on reducing the risk of rabies transmission by ensuring widespread dog immunisation, dissemination of public awareness campaigns, and enhanced availability of PEP.

Case Definition: Suspected Human Rabies Case

A suspected human rabies case is a person with clinical symptoms (any incident involving dogs, cats, bats, and monkeys) of acute neurological syndrome (i.e., encephalitis) dominated by forms of hyperactivity (furious rabies) or paralytic syndromes (paralytic rabies) progressing towards coma and death (15). The first symptoms may include flu-like fever, headaches, and exhaustion. Anxiety, confusion, hallucinations, and swallowing problems develop as the illness progresses. Later, infection may cause muscular spasms, convulsions, and paralysis. These symptoms are typically accompanied by severe light and water sensitivity, which can make drinking or swallowing frightening (4). However, any bite or scratch with a suspected rabid animal, as well as any incident involving dogs, cats, bats, and monkeys in rabies-endemic countries, raises suspicions of rabies exposure.

Rabies Post-Exposure Prophylaxis (PEP)

Individuals exposed to suspected rabies, such as all bites involving skin penetration, can develop rabies, although the risk depends on the animal species, the location of the bite, and the severity of the wound (16). Rabies PEP is defined as rabies prevention following animal incidents that cause (usually bleeding) wounds. It consists of administering the rabies vaccine with or without rabies immune globulins (RIG), according to recommendations from the World Health Organization (WHO). Since July 2018, WHO has suggested a rabies PEP protocol that includes two intradermal (ID) injections at the same time (the IPC regimen) over the course of three sessions, one at day 0, three days after the medical assessment, and seven days after that (17). Before July 2018, IPC used the modified Thai Red Cross regimen of simultaneous 2-site ID injections in 4 sessions at days 0, 3, 7, and 28 (18). The severity of the wound from a suspected rabid animal, along with the exposure risk and other relevant indicators, determines the recommendation for administering PEP.

Rabies Pre-Exposure Prophylaxis (PrEP)

People traveling to rabies-endemic countries, as well as those with potential occupational exposure, such as veterinarians or laboratory personnel, should consider PreP. We have changed the previous 3-dose intramuscular (IM) PrEP schedule to a 2-dose regimen,

administered on days 0 and 7. People who received PrEP more than three months ago will still receive one dose (ID or IM) of the vaccine as a booster after a bite or scratch incident.

Access to Rabies PEP in Cambodia

Unfortunately, a considerable proportion of Cambodians, especially in rural areas, have challenges accessing rabies PEP in terms of awareness, availability, and affordability (3). There are a limited number of sites that provide PEP: besides the Angkor Children's Hospital in Siem Reap, the National Public Health Institute in Phnom Penh, and some private clinics, IPC operates three Rabies Prevention Centers across the country, with the one in Phnom Penh serving as the primary center operating since 1998 (13).

Baron et al. (2022) found a negative association between the patients' travel duration to IPC's Rabies Prevention Center and the percentage of PEP patients, i.e., when the travel time increased by one hour, the PEP rate decreased by 70-80% (13).

Before the social media event, IPC had two rabies prevention centers. One is located in Phnom Penh (opened in 1995), and another one is in Battambang, in the northwest of Cambodia, and opened in July 2018. However, in response to the fallout from the social media event in February 2019, IPC opened one more rabies prevention center, located in Kampong Cham, a town 120 km northeast of Phnom Penh, in March 2019.

Social Media in Cambodia

Over the last decade, the total number of social media (Facebook, LinkedIn, Instagram, and TikTok) users in Cambodia has rapidly increased (19). In 2014, there were an estimated 1.2 million social media users in Cambodia. By 2018, the overall number of users had nearly doubled (20). In 2020, the number surged to 9.7 million, and by 2023, it stands at an estimated 12.6 million, accounting for approximately 70% of the total population. This represents an annual increase of approximately 1.3 million users over the previous nine years (19). Facebook is one of the most widely used social media networks in Cambodia. Cambodians use Facebook for communication and leisure; however, it is difficult to quantify the proportion of the population that has access to and extensively uses this platform (20). The country went from having Facebook as the only accessible social platform to currently having all international social media applications available within the country. However, like the rest of the world, "fake news," misinformation, and disinformation have inundated social media in Cambodia in recent years. The Cambodian government has increased its attempts to regulate the spread of incorrect information and uses social media to disseminate its own messages and information, with

Facebook remaining a prevalent platform (17). As social media is so important for communication in Cambodia, it can act as a catalyst for public health awareness and influence health seeking behaviours. Particularly for rabies, publicly shared information may raise awareness and encourage individuals to seek rabies prevention; on the other side, it may spread misinformation and fear, leading to inappropriate rabies PEP seeking behaviour after exposure. The data from the incident investigated in this report provides an understanding of pre- and post-event knowledge, attitudes, and practices regarding injury types, animals involved, and patient characteristics.

Rabies Case Posted on Facebook in 2019 Leading to Increased PEP Demand

A suspected rabid cat bit a 10-year-old girl in early December 2018 in Svay Rieng province in southern Cambodia, a region bordering Vietnam. Her parents, garment factory employees, were unaware of the serious implications of the bite. Therefore, the family did not seek rabies PEP immediately. In February 2019 (exact date not available), the girl developed symptoms such as hallucinations and confusion (21), and her family took her to Vietnam for medical care due to the proximity of her residence to the Vietnamese border.

Her family accompanied her to IPC on February 13, 2019, seeking medical intervention after a Vietnamese physician denied her treatment. However, the doctor did not provide PEP to the girl, citing her already typical and severe rabies symptoms as evidence that it would not save her. Therefore, the parents returned home with her, where she succumbed to her illness later that day (21).

The father had filmed her dying of rabies and posted it on Facebook. Social media widely circulated the girl's video, evoking shock, and expressions of pity as her symptoms worsened. She was visibly suffering in the video, acting abnormally and unable to control herself before eventually falling unconscious. Many accompanying comments suggested that she was suffering from rabies and advised viewers to be cautious of cat bites.

In the week following this social media event, thousands of people started arriving at IPC each day in a rush to seek rabies PEP. This extreme increase in people seeking PEP lasted for several months. This situation was an enormous challenge for IPC due to the rapid increase in PEP demand and resulting in the need for additional staff and plus shortage of vaccine to meet the sudden surge in demand (22).

The Phnom Penh Rabies Prevention Centre received a significant influx of people who sought it out in response to animal bite incidents. In this study, we included patients who met the

criteria for PEP administration (132,391 PEP patients). As a result, in 2019, 78,691 patients received rabies PEP at the three IPC Rabies Prevention Centers throughout Cambodia, which was the triple number of PEP administrations compared to 2018 (n = 26,282). For this study, we utilised the database at the Phnom Penh Rabies Prevention Center for analysis, as it also covers the years before the social media event.

Objectives

This study describes the impact of a social media posting from February 2019 on PEP seeking behaviours of patients, and uses data collected at the Rabies Prevention Center of IPC in Phnom Penh, recorded to examine PEP uptake and patients' characteristics.

The aims were:

1) to use data from the Rabies Prevention Center of IPC in Phnom Penh recorded during 2017-2020 to examine the PEP uptake and patient's characteristics, and tested animal samples,

2) to understand how a social media event can affect the number of people seeking rabies PEP at IPC and the way they seek it by comparing data before and after the event.

The hypothesis tested in this study was that a social media event (in this case on Facebook) showing a subject with rabies-like symptoms would induce a change among patients seeking PEP.

2.1 Methods

1. **Study site**

Cambodia's capital and largest city is Phnom Penh. According to the 2019 National Report of the National Institute of Statistics, Cambodia's overall population reached 15,552,211, with 2,281,951 people residing in Phnom Penh (10). The Phnom Penh Rabies Prevention Center is the most frequented rabies vaccination center in Cambodia (16). In the months following the social media event, the Phnom Penh Rabies Prevention Center had difficulties providing PEP to all patients who sought treatment. These difficulties were caused by a shortage of rabies vaccines and an insufficient number of staff members to deal with the dramatic surge in patients seeking PEP.

2. Study population

The study population was meticulously chosen from the entirety of patients meeting the eligibility criteria for Post-Exposure Prophylaxis (PEP) at the Phnom Penh Rabies Prevention Center. Recruitment for this population commenced at IPC between February 1, 2017, and December 2020. Our project involved a retrospective analysis of these secondary data.

3. Information sources about the social media event

We conducted a retrospective media search, reviewing online newspapers and Facebook postings for rabies-related information in Cambodia for 2019 using Boolean search terms alone or in combination including: “Rabies”,” Rabies PEP”, “Social media data”, “a girl died of cat bite in 2019” “Rabies panic”, “Svay Rieng girl died after contacting cat” and “Rabies phobia in 2019”.

4. Data collection

Demographic data, individual PEP patient information such as sex, age, residence, medication, characteristics of the animal incident, and, if the animal carcass was provided, also the rabies diagnostic result of the animal (Appendix 2.3) was extracted from the database of the Rabies Prevention Center at IPC. The Case report form used for the initial documentation of each patient can be found as Appendix 2.4.

Using the Epidata software, we carefully entered the data. We carried out a comprehensive cleaning procedure before analysis to maintain data integrity. To improve the validity of our dataset, we removed redundant records. We also conducted a thorough review of the data to identify and rectify any potential errors, discrepancies, or instances of missing or incomplete information.

5. Statistical analysis:

An analysis of the PEP dataset from IPC (for the period two years before and two years after social media event) using Stata and QGIS was undertaken. In addition, an analysis of the PEP-related rabies diagnostic on animals during the study period was conducted to further investigate trends in health-seeking behaviour.

We compared two distinct periods: the initial 24 months spanning from February 1, 2017, to January 21, 2019, prior to the social media event and a subsequent 23-month period interval from 1st February 2019 to 31st December 2020. The study compared the 24 months between 1 February 2017 and 31 January 2019 prior to the social media event and a period of 23 months between 1st February 2019 and 31st December 2020 (83,762 PEP patients) following the social media event. We performed descriptive analyses to study the demographic characteristics of PEP patients and presented the findings as percentages or medians along with their corresponding interquartile ranges. Comparative assessments of variables were executed employing Chi-square tests and t-test analyses. Significance was established for probability values below 0.05, and we calculated 95% confidence intervals to support our findings.

Univariate and multivariate Poisson regression analysis with robust error variance was used to compare characteristics of patients before and after the event including a) Central/plain area (Phnom Penh, Takeo, Kampong Cham, Svay Rieng, Prey Veng, Kandal, Tboung Khmum, Kampong Chhnang, Pursat, Battambang, Banteay Meanchey, Siem Reap, Kampong Thom, Oddar Meanchey, Pailin) b) Coastal area (Koh Kong, Kampong Som, Kampot, Kep) and c) Plateau/mountainous area (Kratie, Steung Treng, Mondolkiri, Rattanakiri, Preah Vihear, Kampong Speu). We utilised the "Growth Rate" to represent the annual increase in the percentage of PEP residents between two time points. The Growth Rate was calculated as follows: [Growth Rate = ((Present value – Initial value)/Initial value)) x 100] (24). Statistical analysis was performed using STATA (version 17; Stata Corp, College Station, Texas, USA) (25) and QGIS software and QGIS software (version 3.28.3) (26) was used to generate graphics and maps.

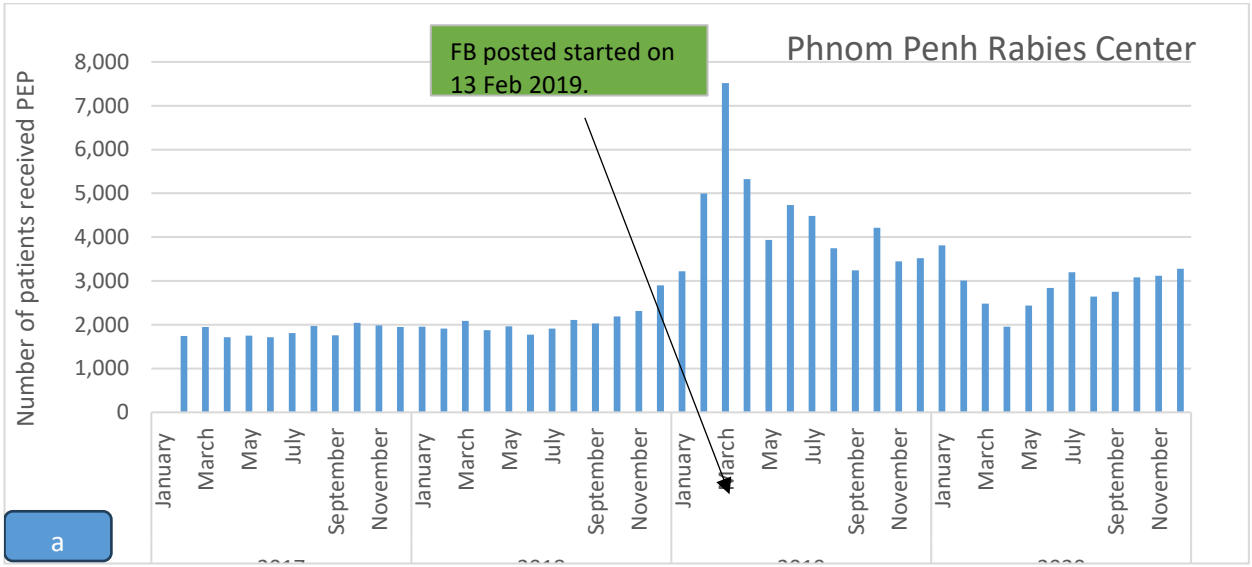
6. Ethical Approval

Analysed data originate from routine data collected as part of the PEP service of IPC's Rabies Prevention Center. We obtained informed consent from each patient for the use and analysis of their information from the PEP records. Therefore, additional approval from the National Ethic Committee for Health Research (NECHR) is not required. The study was approved by the Human Research Ethics Committee (HREC) at ANU and obtained on 26 July 2022 (number 480/2022).

2.2 Results

Study population description

Figure 2.1 presents data on annual presentations from 132,391 individuals who received PEP at the Phnom Penh Rabies Prevention Center at IPC between February 1, 2007, and December 31, 2020. On average, around 2,000 patients per month received PEP between February 2017 and November 2018. Notably, the number of PEP patients increased from approximately 3,000 in December 2018 to 7,000 in March 2019. Following the social event posting in February 2019, the Phnom Penh Rabies Prevention Center saw a substantial increase in the number of people accessing PEP.



a) The number of PEP patients per month from 1st February 2017 to 31st December 2020.

b) News coverage of the surge in people seeking PEP at IPC in February 2019.

Figure 2.1: PEP patients at Phnom Penh IPC Rabies Prevention Center and media footage of the increased demand of PEP in 2019

Unravelling Social Media Discourse: Investigating the Tragic Incident of a Child Bitten by a Cat in 2019

There was no thematic analysis of the social media posts. The information from the February 2019 social media search revealed insightful observations about community behaviour. Media messages illustrated that people exhibited caution and maintained a heightened awareness regarding animal bites. Discussions on social media platforms amplified their concern that any biting animal could potentially carry rabies, motivating their warnings. As a result, many individuals promptly sought out the Rabies Prevention Center in Phnom Penh, IPC.

Numerous individuals came to Phnom Penh for rabies PEP and released their dogs and cats at pagodas because of panic that they could carry rabies.

"Panic-stricken Cambodians by the thousands are now lining up outside Pasteur Institute in Phnom Penh seeking vaccinations against rabies. Meanwhile, animal welfare advocates are worried that the fear of rabies could put both dogs and ***cats*** *at risk of being killed and abandoned," Taing Rinith reported* (22).

The sharing the death of the girl through social media was followed by the death of another man due to rabies. As a result, people feared animal bites more.

"Rabies panic took over the Kingdom during the past few weeks after news spread on social media that a young girl died from the disease after being ***bitten by a cat****, followed by news of a man dying in Tboung Khmum province, where many villagers did not understand how deadly the disease could be." Khmer Times* (27).

The fact that individuals shared information about the symptoms of rabies with their friends and family caused fear and panic.

"Now we are always afraid. Our elders told us people infected by rabies are scared of water and it is true; when we brought my friend to a traditional healer and put water on him, he was scared." One villager in Tboung Khum province (27).

People took animal bites much more seriously, particularly cat bites. They realised that they must visit a doctor immediately after being bitten by an animal. As a result, more people seek out medical evaluation at rabies treatment centers .

"I lost my lovely daughter, so I call on everyone to pay attention and to go to the doctor straight away when ***bitten by a cat*** *or other animals. Do not do like me. If it is rabies, it cannot be cured." A farther of the child* (28).

There was a rush on rabies vaccines in Cambodia, and health officials were urging calm. The message emphasises that individuals bitten by animals should prioritise receiving the vaccine, not everyone else. They were working to address the shortage but recommended avoiding contact with stray dogs and cats to prevent bites in the first place.

"I want to appeal to people across the country not to be panicked since many people have flocked to get rabies vaccination at Pasteur Institute and other places. Some people are not bitten by dogs, but they also came to get vaccination, The Ministry of Health has already worked on that issue. We make our efforts to solve it but those who are not ***bitten by*** *a dog or* ***a cat****, have also came so it is difficult for those who really need vaccination" Prime Minister said* (29).

As the increased demand for PEP strained the IPC Rabies Prevention Center in Phnom Penh, the Ministry of Health tried to calm the population by announcing the opening of an additional rabies prevention center in Kampong Cham in March, as reported in the major English newspaper in Cambodia, the Phnom Penh Post, on February 25th, 2019 (30).

Two weeks after the initial post of the death of the girl after a cat bite and another report of a man's death in Tboung khmum province, the rabies panic spread across whole Cambodia as many people realized how deadly the disease is. Consequently, the number of PEP requests to all Rabies Prevention Centers rose dramatically, as shown in Figure 2.1.

Comparison of patient's characteristics before and after the event

Spatial distribution of residence of patients

The PEP patients that the Phnom Penh Rabies Prevention Center treated between February 2017 and 2020 were from 25 provinces across Cambodia (Figure 2. 2). Following the social media event, we observed a surge in the number of individuals seeking PEP from provinces far away from the Rabies Prevention Center in Phnom Penh, indicating that the event had a more pronounced effect on populations living farther away from the PEP center. Specifically, the growth rate of PEP patients in rural areas such as Steung Treng, Svay Reing, Kampong Soam provinces, and Kep City grew threefold following the event.

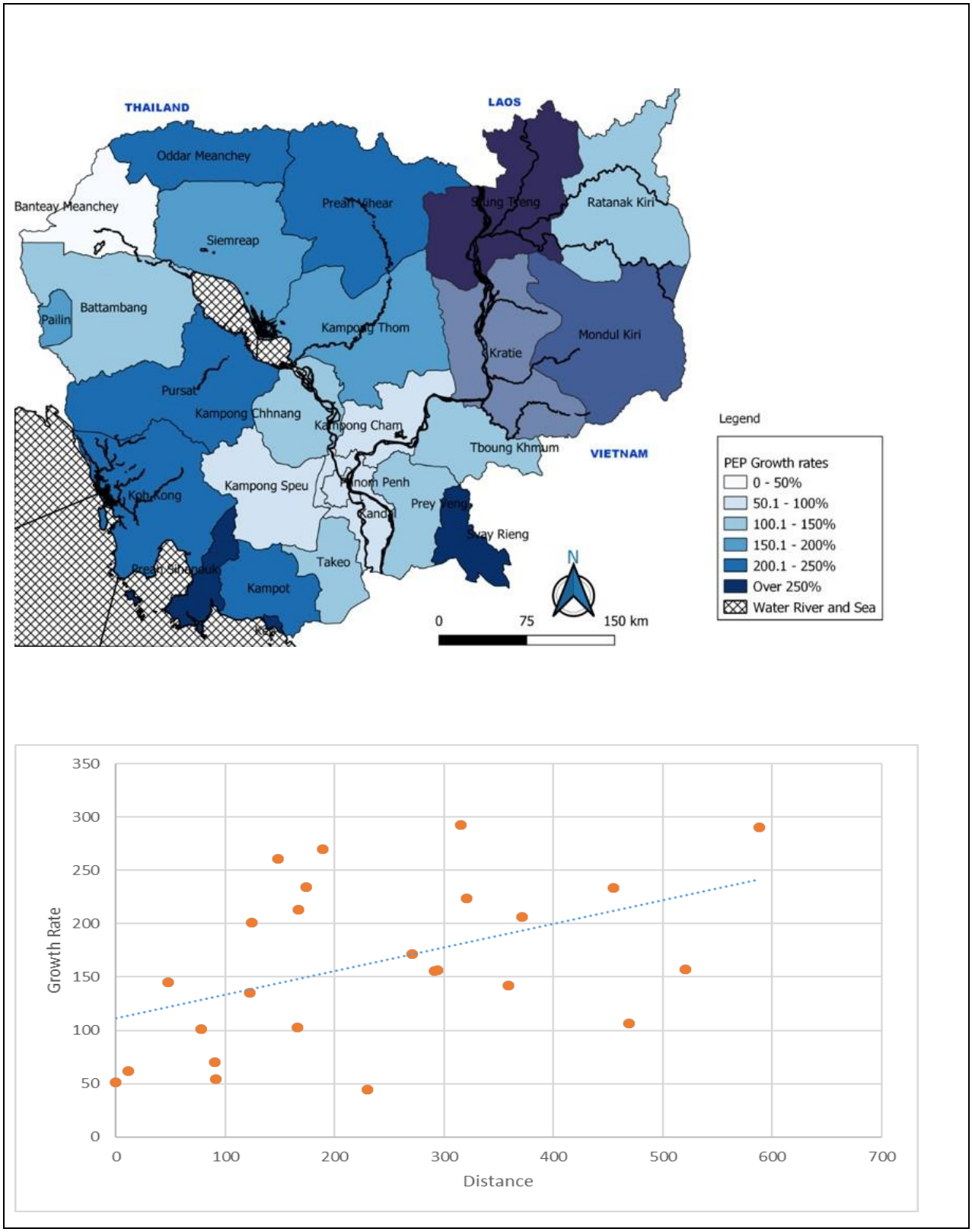


Figure 2. 2: Geographic distribution and growth rate from 1 February 2017 to 31 December 2020, IPC, Cambodia (N=132,391)

Social demographic of the PEP patients

A total of 132,391 patients went to the Phnom Penh Rabies Center for Rabies vaccination during the whole study period with a substantial significant increase of PEP patient numbers in the period after the social media event when compared to the time before (P <0.001). After the social event, the proportion of female PEP patients was slightly higher (51.74%) after the social event compared to the 2 years before (49.31%), and the number of PEP patients above the age of 15 increased slightly for each age categories (Table 2. 1).

Table 2. 1. PEP patient characteristics before and after the social media event

	Pre-social media event N=48,623				Post-social media event N=83,768			
	N	%	Median	IQR	N	%	Median	IQR
Sex								
Male	24,646	50.69			40,428	48.26		
Female	23,977	49.31			43,340	51.74		
Age (years)			23.91	(2-37)			24.86	(1-39)
Age -group								
0-15	23,039	47.38			37,145	44.34		
16-30	8,923	18.35			16,339	19.51		
31-45	8,159	16.78			15,182	18.12		
Over 46	8,502	17.49			15,102	18.03		

As the girl in the original social media post was from Svay Reing province, the rise in the PEP rate for this province was of interest. The percentage of PEP patients from Prey Veng increased from 6.66% (n = 3,240) to 9.47% (n = 7,929). This increase mirrored the trend in the

neighboring province of Svay Rieng, where the PEP patient rate rose from 1.22% (n = 592) to 2.55% (n = 2,137) in Table 2. 2.

Table 2. 2. Provinces of residence for PEP patients

	Pre-social media event N=48,623		Post-social media event N=83,768	
	N	%	N	%
Provinces of resident				
Phnom Penh	23,845	49.04	36,017	43.00
Kandal	9,845	20.25	15,969	19.06
Prey Veng	**3,240**	**6.66**	**7,929**	**9.47**
Kampong Speu	2,240	4.61	3,819	4.56
Takeo	**2,094**	**4.31**	**4,220**	**5.04**
Kampong Cham	3,684	7.58	5,696	6.80
Kampot	608	1.25	1,828	2.18
Svay Rieng	**592**	**1.22**	**2,137**	**2.55**
Kampong Chhnang	**821**	**1.69**	**1,934**	**2.31**
Kampong soam	**79**	**0.16**	**292**	**0.35**
Koh Kong	**39**	**0.08**	**122**	**0.15**
Pursat	**116**	**0.24**	**388**	**0.46**
Battambang	**109**	**0.22**	**221**	**0.26**
Banteay Meanchey	74	0.15	107	0.13
Siem Reap	**74**	**0.15**	**201**	**0.24**
Kampong Thom	**642**	**1.32**	**1,641**	**1.96**
Preah Vihear	**25**	**0.05**	**81**	**0.10**
Kratie	**96**	**0.20**	**246**	**0.29**
Steung Treng	**13**	**0.03**	**51**	**0.06**
Mondolkiri	**16**	**0.03**	**49**	**0.06**
Rattanakiri	**24**	**0.05**	**58**	**0.07**
Oddar Meanchey	**18**	**0.04**	**60**	**0.07**
Pailin	**7**	**0.01**	**18**	**0.02**
Kep	**10**	**0.02**	**39**	**0.05**
Tboung Khmum	**312**	**0.64**	**645**	**0.77**

Table 2. 3 presents an overview of bite incidents and PEP parameters before and after the social media event. Our analysis revealed that the proportion of individuals seeking PEP due to an animal scratch increased from 1.82% (n = 886) to 4.83% (n = 4046) among PEP patients, while those who encountered a bite including a scratch rose from 0.05% (n = 24) to 2.95% (n= = 2475). The incidence of reported spontaneous animal attacks increased from 55.70% (n = 27,081) to 65.62% (n = 54,967) after the occurrence. In June 2018, IPC adjusted the PEP and shortened the schedule to three visits. Therefore, 90.78% (n = 76,042) of patients in the post-social media group completed their PEP course within three sessions, whereas the pre-social media event group includes patients that received a four-visit PEP schedule.

Table 2. 3. Characteristics of bite incidents and PEP treatment before and after social media event

	Pre-social media event N=48,623		Post-social media event N=83,768	
	N	%	N	%
Type of exposure				
Bite	47,680	98.06	77,191	92.15
scratch	**886**	**1.82**	**4,046**	**4.83**
Licking	33	0.07	56	0.07
Bite and scratch	**24**	**0.05**	**2,475**	**2.95**
Type of attack				
Spontaneous	**27,081**	**55.70**	**54,967**	**65.62**
Provoked	21,542	44.30	28,801	34.38
Main of exposure				
Head	2,796	5.75	4,677	5.58
Neck	227	0.47	201	0.24
Body	3,010	6.19	4,695	5.60
Arm	**3,522**	**7.24**	**6,827**	**8.15**
hand	4,767	9.80	7,113	8.49
Finger	**5,369**	**11.04**	**13,309**	**15.89**
Leg	18,537	38.12	30,449	36.35
Foot	10,316	21.22	16,363	19.53
Genital	79	0.16	134	0.16
Days between accident to PEP				
≤ 1	31,735	65.27	52,693	62.90
2-3	**7,543**	**15.51**	**14,111**	**16.85**
≥ 3	**9,345**	**19.22**	**16,964**	**20.25**
Number doses for patient received PEP				
1	2,612	5.37	2,385	2.85
2	5,217	10.73	5,341	6.38
3	**39,107**	**80.43**	**76,042**	**90.78**
4*	1,687	3.47	0	0

***Since June 2018 only 3 doses as a completion of PEP**

There was a notable increase in the proportion of cat bites among those receiving PEP in Table 2. 4 with the proportion rising from 15.69% (n=7,630) to 38.35% (n=32,124). Conversely, the proportion of dog bites reported declined from 83.26% (n=40,482) to 60.43% (n=50,624) after the social media event.

Table 2. 4. Characteristics of the animal incidents before and after the social media event

	Pre-social media event N=48,623		Post-social media event N=83,768	
	N	%	N	%
Type of biting animal				
Dog	40,482	83.26	50,624	60.43
Owned	39,828		42,850	
Unknown	654		7,774	
Cat	**7,630**	**15.69**	**32,124**	**38.35**
Owned	7,407		24,592	
Unknown	223		7,532	
Monkey	345	0.71	689	0.82
Others*	166	0.34	331	0.40
Aggression				
Spontaneous	**27,081**	**55.70**	**54,967**	**65.62**
Provoked	21,542	44.30	28,801	34.38
Aspect				
Healthy	**46,544**	**95.72**	**81,395**	**97.17**
Sick	2,079	4.28	2,373	2.83
Ownership				
With Owner	47,661	98.02	68,056	81.24
Without Owner	**961**	**1.98**	**15,699**	**18.74**
Wild animal	1	0.00	13	0.02
Status of the animal				
Put down	3,133	6.44	4,140	4.94
Died	315	0.65	1,082	1.29
Disappeared	**1,260**	**2.59**	**7,121**	**8.50**
Alive	43,915	90.32	71,425	85.27

***Pig,rabbit,bat,squirrel**

Rabies testing of animals involved in bite incidents

Over the whole study period, the heads of 801 animals involved in bite incidents were analysed by IPC's Virology Unit. The number of dog heads (n=766) was still disproportionately higher than the number of cat heads (n=34). The positivity decreased (5/11 positive versus 3/23) in Table 2. 5. These data were incomplete as IPC was forced to stop testing animal heads for a while after the social media event due to the amount of animal heads overwhelming the capacity of the Virology Unit.

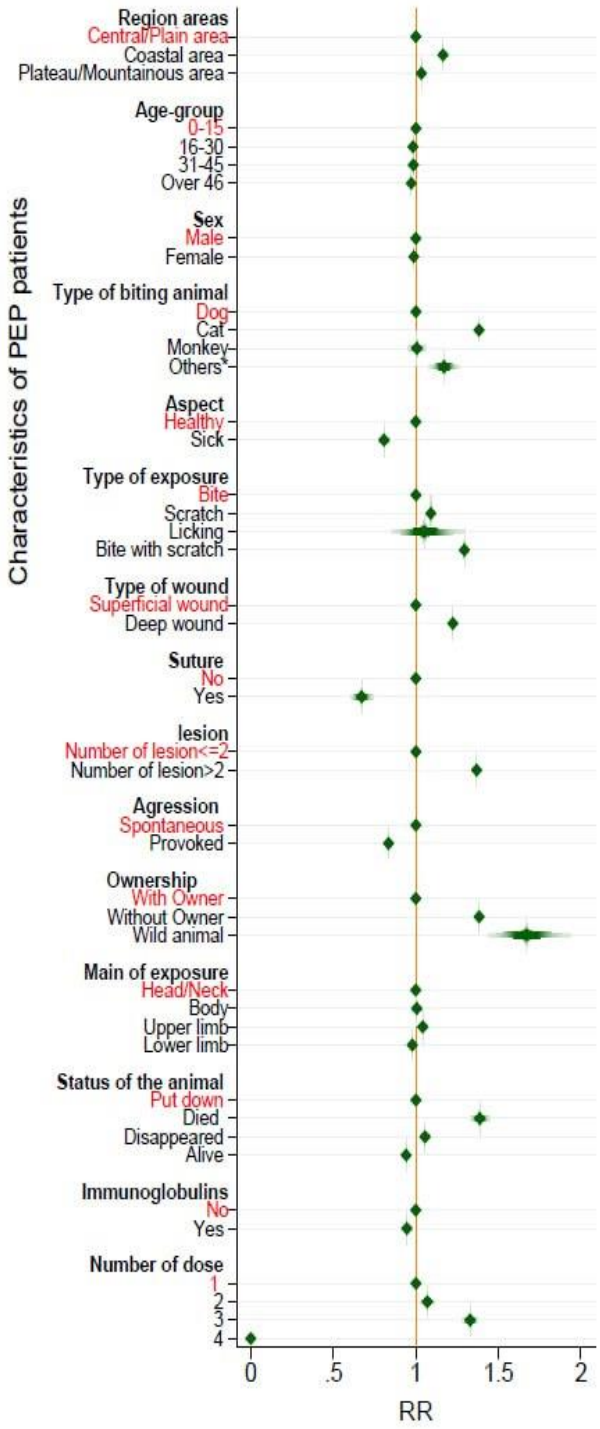
Table 2. 5. Rabies animal diagnostic before and after social media event

Samples	Result	Pre-social media event N=429 (%)	Post-social media event N=372 (%)
Dog	Positive	302(70.40)	270(72.58)
	Negative	115(26.81)	78(20.97)
	Not tested**	1(0.23)	0
Cat	Positive	5(1.17)	3(0.81)
	Negative	**6(1.40)**	**19(5.11)**
	Not tested**	0	1(0.27)
Rabbit	Positive	0	0
	Negative	0	1(0.27)
	Not tested	0	0
Total	Positive	307(71.56)	273(73.39)
	Negative	121(28.20)	98(26.34)
	Not tested*	1(0.23)	1(0.27)

** Not tested due to insufficient sample quality

Multivariate Poisson regression analysis of the PEP patients

The multivariate regression analysis showed a greater impact of the social media event on resident areas as central/plain, coastal or mountainous from the Phnom Penh Rabies Prevention center and on people that had potential exposed to rabies via a cat attack in. Using a multivariate Poisson model, the changes in the characteristics of PEP patients due to the social media event were analysed. In the period after the social media event, the following categories were significantly increased: (I) cat bites, (ii) exposures to animals other than dogs, (iii) exposures to animal that appeared healthy (iv) upper limb bites, and (v) residents in coastal area. Spontaneous attacks, deep wounds, multiple lesions (>2), incident with ownerless animal, and the fact that the animal involved in the bite incident was already dead when people where seeking PEP were also more frequently reported by people after the social media event. Individuals who received immunoglobulins were significantly less common in the time after the social media event. The model also showed the impact of the changing vaccination protocol indicated on the number of doses received by patients in Figure 2. 3.



Variable	Number	Unadjusted RR	Unadjusted 95%CI	Unadjusted p-value	Adjusted RR	Adjusted 95%CI	Adjusted p-value
Region areas							
Central/Plain area	122,656		Reference			Reference	
Coastal area	3,017	1.20	1.18,1.23	**<0.001**	1.16	1.14,1.19	**<0.001**
Plateau/Mountainous area	6,718	1.02	1.00,1.04	0.056	1.03	1.02,1.05	**<0.001**
Age -group							
0-15	60,184		Reference			Reference	
16-30	25,262	1.05	1.04,1.06	**<0.001**	0.98	0.97,0.99	**0.001**
31-45	23,341	1.05	1.04,1.07	**<0.001**	0.98	0.97,1.00	**0.004**
Over 46	23,604	1.04	1.02,1.05	**<0.001**	0.97	0.96,0.98	**<0.001**
Sex							
Male	65,074		Reference			Reference	
Female	67,317	1.04	1.03,1.04	**<0.001**	0.99	0.98,1.00	**0.001**
Type of biting animal							
Dog	91,106		Reference			Reference	
Cat	39,754	1.45	1.44,1.47	**<0.001**	1.38	1.37,1.39	**<0.001**
Monkey	1,034	1.20	1.15,1.25	**<0.001**	1.01	0.97,1.05	0.783
Others	497	1.20	1.13,1.28	**<0.001**	1.17	1.10,1.24	**<0.001**
Aspect (Health of animal)							
Healthy	127,939		Reference			Reference	
Sick	4,452	0.84	0.81,0.86	**<0.001**	0.81	0.78,0.83	**<0.001**
Type of exposure							
Bite	124,871		Reference			Reference	
Scratch	4,932	1.33	1.31,1.35	**<0.001**	1.09	1.08,1.11	**<0.001**
Licking	89	1.02	0.87,1.19	0.828	1.05	0.90,1.23	0.540
Bite with scratch	2,499	1.60	1.59,1.61	**<0.001**	1.29	1.28,1.31	**<0.001**
Type of wound							
Superficial wound	122,685		Reference			Reference	
Deep wound	9,706	1.19	1.17,1.20	**<0.001**	1.22	1.21,1.24	**<0.001**
suture							
No	131,632		Reference			Reference	
Yes	759	0.68	0.62,0.73	**<0.001**	0.67	0.62,0.73	**<0.001**
Lesion							
Number of lesions <=2	125,395		Reference			Reference	
Number of lesions >2	6,996	1.53	1.52,1.54	**<0.001**	1.37	1.36,1.38	**<0.001**
Aggression							
Spontaneous	82,048		Reference			Reference	
Provoked	50,343	0.85	0.85,0.86	**<0.001**	0.83	0.83,0.84	**<0.001**
Ownership							
With Owner	115,717		Reference			Reference	
Without Owner	16,660	1.60	1.59,1.61	**<0.001**	1.38	1.37,1.39	**<0.001**
Wild animal	14	1.58	1.37,1.83	**<0.001**	1.67	1.49,1.87	**<0.001**
Main of exposure							
Head/Neck	7,901		Reference			Reference	
Body	7,918	0.99	0.96,1.01	0.332	1.01	0.98,1.03	0.638
Upper limb	40,907	1.08	1.06,1.10	**<0.001**	1.04	1.02,1.06	**<0.001**
Lower limb	75,665	1.00	0.98,1.02	0.823	0.98	0.96,1.00	**0.015**
Status of the animal							
Put down	7,273		Reference			Reference	
Died	1,397	1.36	1.31,1.41	**<0.001**	1.39	1.34,1.43	**<0.001**
Disappeared	8,381	1.49	1.46,1.53	**<0.001**	1.05	1.03,1.08	**<0.001**
Alive	115,340	1.09	1.07,1.11	**<0.001**	0.94	0.92,0.96	**<0.001**
Immunoglobulins							
No	125,403		Reference			Reference	
Yes	6,988	0.92	0.91,0.94	**<0.001**	0.94	0.92,0.97	**<0.001**
Number of doses							
1	4,997		Reference			Reference	
2	10,558	1.06	1.02,1.10	**0.001**	1.07	1.04,1.10	**<0.001**
3	115,149	1.38	1.34,1.42	**<0.001**	1.33	1.29,1.37	**<0.001**
4	1,687	_	_	_	_	_	_

Figure 2. 3. Multivariate Poisson regression analysis of PEP characteristics [1]

[1] Noted: Red as a reference and the table corresponding to the figure.
*Type of other bitten animals: Pig, rabid, bat, squirrel

2.3 Discussion

Rabies, though often neglected, is a major public health problem in Cambodia. Our study has shown that a single social media event led to a significant and sustained increase in consultations for PEP, as well as increased awareness among the population. Post-event, there was a notable increase in PEP demand, particularly among individuals with potentially less severe exposures (such as healthy animals, wounds not requiring sutures, scratches), spontaneous bites, injuries from animals reported dead upon presentation or without an owner, and deep and multiple injuries that were more frequently reported by patients after the event. This study demonstrated the rapid spread of disease-related fear through social media platforms. The study highlights the influence of social media in disseminating anxiety, which logically suggests that providing precise facts can be an effective strategy and potential tool for combating this issue in the future.

In 2019, there was a surge in the number of individuals seeking rabies PEP following animal attacks, due to media coverage of a fatal incident involving a rabid cat bite. Following the social event, there was an evident change in individuals' behaviour leading to an increased surge in PEP demand, suggesting an increased level of awareness for the risk of rabies among the Cambodian people. Following an animal bite, individuals immediately sought treatment at the Phnom Penh Rabies Prevention Center, IPC.

In the context of developing nations, it has been founded that stray or free-roaming dogs are the primary cause of bite injuries in urban areas (31). In Cambodia the understanding of the incidence of cat bites has to date been constrained by limited data. However, this study observed an increase in reported cat bites following an initial report of such an event, suggesting that increased awareness of rabies transmission risk from cats may impacted health-seeking behaviour.

Animal bite prevention needs to focus on getting all children and parents involved to increase awareness of the health-related impact of any animal bites (32–34) Currently, there are no studies available on the risk of rabies from cat bites in Cambodia and only a few from cat-associated rabies risk from the US and Brazil (35–37). The Cambodian government, in collaboration with international organisations, is now engaged in the development of a comprehensive national strategic plan to eliminate dog-mediated human rabies deaths by 2030. In terms of elimination, cats should also be considered as an important risk factor in the transmission of rabies to humans, just like dogs. Therefore, mandatory cat

vaccination was part of the successful rabies elimination strategies in Western Europe, Canada, Japan and Taiwan (38–41).

The analysis of the demography of PEP-seeking people revealed a strong correlation between distance via road, journey time, and travel expenses, making PEP treatment unfavourable with increasing distance to a PEP center(7). However, the impact of the social media event in mid-February 2019 led to a significant change. It was observed that PEP patients from more distant areas began seeking treatment at to the Phnom Penh Rabies Prevention Center.

The reviewing of social media enhanced our understanding of health-seeking behaviors and the community's perception of the risk associated with rabies during the 2019 social media event.

This study provides useful information to enhance the overall awareness of the existing gaps and difficulties related to rabies PEP in Cambodia. The insights gained, could inform the development of public health policies, guide the implementation of rabies control activities, and support the development of rabies prevention and control strategies. One promising approach is leveraging social media as a platform for disseminating public health messages with the aim of positively influencing the health-seeking behaviours of individuals.

Limitations

At the time of the study, in Cambodia, there were five public PEP centers and many private clinics providing PEP. However, in this study, we utilised only data from the IPC Rabies Prevention Center in Phnom Penh. It is the country's major PEP center, receiving 70–80% of PEP patients in Cambodia. Furthermore, there is a bias towards seeking PEP at one of the IPC Rabies Prevention Centers because the service is affordable and known for its high-quality standards, in contrast to the soaring prices requested at private clinics. A potential selection bias emerged in 2019 because, due to the high number of patients, IPC's Rabies Prevention Centers started screening patients and providing PEP only to those meeting specific criteria. As a result, non-eligible patients did not receive PEP, and the database never included their records. Moreover, this analysis only includes patients who sought care at the Phnom Penh Rabies Prevention Center, leaving out a critical population that did not seek medical treatment. Furthermore, it is crucial to acknowledge the absence of laboratory testing to verify rabies

cases and the possible bias in recall, as limited resources halted testing during the peak of PEP demand. These factors constrained the scope of this analysis.

Recommendations

The Cambodian Ministry of Health has expressed concern over incidents of dog bites, but cat-related injuries have received relatively little attention so far. There appears to be an oversight in the government's communication strategy regarding the risk of rabies from cats and other animal species. In order to contribute to the global goal of eliminating human fatalities due to dog-mediated rabies by 2030, governments and international organisations must collaborate closely to ensure widespread vaccination distribution to animals, especially dogs and cats.

In Cambodia, the distance between certain rural provinces and the next rabies vaccination center is a significant challenge for many people who need rabies PEP after animal bites. Many people live in rural areas, where access to rabies vaccines is often hindered by the long distances and the limited number of rabies treatment centers. To address this challenge, the Cambodian government has implemented several initiatives to improve access to rabies vaccines in rural areas, these include training of healthcare workers in identification, treatment of rabies and expanding the availability of rabies vaccines in remote areas (42).

Moreover, controlling information disseminated via social platforms is critical to avoiding the spread of misinformation. Misunderstandings about rabies risks, as illustrated by this social media event, can lead to dangerous underestimations. This research emphasizes the importance of sharing accurate and accessible information on rabies through social media and other platforms. It also demonstrates the significance of using these platforms for educational purposes.

2.4 Conclusion

The influence of social media on health-seeking behaviour, particularly in the choice to seek PEP, was a strong factor in the rapid increase in PEP demand. The widespread social media post about the death of a child from rabies had an impact on health seeking behaviour, particularly following cat bites. A key contributing factor to rabies exposure was identified as children under the age of 16. The ease of access to social media facilitated the rapid spread of these posts. Furthermore, in line with the goal of eliminating human death caused by dog-mediated rabies by 2030, social media could serve as vital tool for disseminating information

to the Cambodian population increasing knowledge about rabies. However, monitoring and mitigating the information on social media is challenging. It is essential that any social media efforts regarding rabies prevention and treatment are factual, evidence-based, and culturally sensitive. In addition, social media initiatives should be part of larger efforts to increase access to PEP and other preventive methods, such as rabies vaccination. The use of social media to communicate evidence-based public health messages could be particularly beneficial in Cambodia. Based on our findings, a well-designed social media campaign by the Cambodian authority such as the Ministry of Health could raise awareness about the importance of PEP for rabies prevention. Ultimately, leveraging social media as a strategic tool in public health campaigns can play a pivotal role in enhancing rabies awareness and prevention, contributing to Cambodia's efforts towards a rabies-free future by 2030.

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Appendix 2.1: Initial results dissemination to World Field Epidemiology Day in Australia, September 2022

Background

Institut Pasteur du Cambodge — Australian National University

- Rabies virus is part of the Rhabdoviridae family, Lyssavirus genus
- Rabies is a preventable disease
- The Rabies Prevention Center at IPC is a major and most active centre for rabies PEP
- A database maintained since 1998
- Estimated around 600,000 people bitten by dogs in Cambodia
  - 3-4 injuries for 100 persons per year*
- **An extremely high probability of being bitten in a rabies-endemic country**
  - Only around 5% consulted a rabies vaccination center*
- **95% of individuals did not receive proper rabies prophylaxis after dog bites***

****Ponsich A et al., 2016***

2

Research objectives

Institut Pasteur du Cambodge — Australian National University

Objectives:

- To use data at Rabies Prevention Centre of IPC in Phnom Penh recorded during 2017- 2020 to examine the PEP uptake and the patients' characteristics.
- To understand an examination of how a social media event can affect the way people seeking rabies PEP at IPC by comparing data before and after the event.

Hypothesis:

- A social media post (Facebook) showing a subject with rabies-like symptoms can induce changes in different aspects among PEP patients including the way people come to received PEP at IPC after being wounded by animals.

3

Methods

- Data source: Phnom Penh Rabies Centre PEP data 2017- 2020
  - Pre- Event: 24 months
  - Post- Event: 23 months
- Patient's consent: Obtained by a medical team
- Social media data: A retrospective media search through social media posts in 2019
- Descriptive analysis: A further analysis will be undertaken time trend, regression and patient characteristics comparing the 2-time periods: 2 years before and 2 years after the social media event.

4

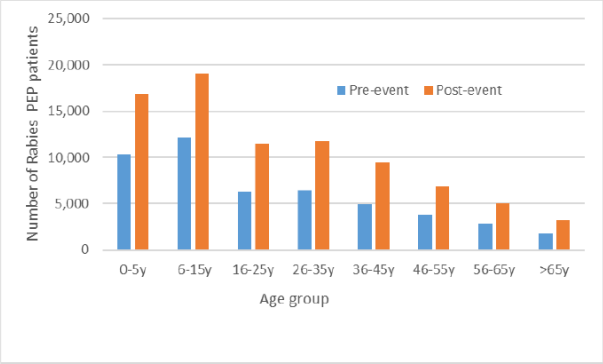
Social media and news following cat bite event

5

Preliminary Results (2)

Institut Pasteur du Cambodge — Australian National University

Figure 2: Comparison of age group for rabies PEP patients between pre and post-event*, at Phnom Penh Rabies Prevention Center, IPC, Cambodia (n=132,391)



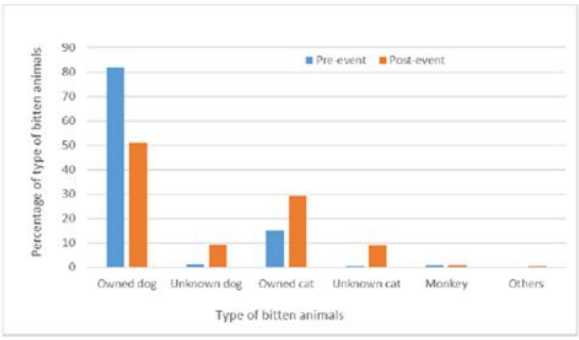
*Pre-event: 1st February 2017 to 31st January 2019
*Post-event: 1st February 2017 to 31st December 2020

7

Preliminary Results (3)

Institut Pasteur du Cambodge — Australian National University

Figure 3: Comparison percentage of type of bitten animals for rabies PEP patients between pre and post-event*, at Phnom Penh Rabies Prevention Center, IPC, Cambodia (n=132,391)



*Pre-event: 1st February 2017 to 31st January 2019
*Post-event: 1st February 2017 to 31st December 2020

Note: Owned refers to animal belong to a family while unknown refers to stray animals
Others refer to Cow, pig, bat, Civet, Rabbit, gibbon.....

8

Discussion

- Rabies is a neglected disease & remains a public health concern in Cambodia
- A social media event had a major impact on increasing rabies PEP uptake
- Mostly, among children under 16 years old
- The majority of human exposures were from cats
- Lack of knowledge of rabies in community in Cambodia

- Limitation: Only data from Phnom Penh Rabies Centre at IPC

- **Public health action is required to improve the uptake of knowledge of rabies in public, especially via social media and in relation to risk from cats**

9

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Dr. Thai Pisey
Mr. Phoeun Chandara
Mr. Sopheak Sorn
Institut Pasteur du Cambodge team
A Rabies Prevention centre team

Thank you for your attention!

10

Appendix 2.2: Presentation for Australian Public Health Association Communicable Diseases & Immunisation Conference 2023, Perth Australia and 13th International Conference on Public Health among the Greater Mekong Subregion Countries 2023 (IPHC GMS13), Hue & Hanoi City, Vietnam

70 ans years 1953-2023 Institut Pasteur du Cambodge

Australian National University

Potential Impact of a Social Media Post in 2019 on Rabies Post-exposure Prophylaxis (PEP) at Institut Pasteur du Cambodge (IPC), Cambodia

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Communicable Diseases and Immunisation Conference 2023
19 – 21 June 2023, Perth

Background on Rabies in Cambodia and PEP at IPC

Rabies is a preventable disease

Endemic in Cambodia

- Lack of vaccine coverage in dogs
- High number of dog bites

Estimated around 600,000 people bitten by dogs in Cambodia**

- 3-4 injuries for 100 persons per year

800 estimated human deaths per year with an incidence of 5.8/100,000 in 2009*

The Rabies Prevention Center at IPC is a major and most active centre for rabies PEP in Cambodia

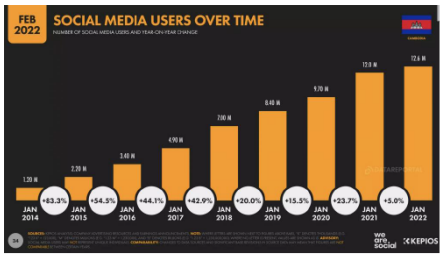
An extremely high probability of being bitten in a rabies-endemic country**

- Only around 5% consulted a rabies vaccination centre

95% of individuals did not receive proper rabies prophylaxis after dog bites**

*Ly et al., 2009.**Ponsich A et al., 2016

Intro on Social Media in Cambodia then Study Question/Objective and Methods



Social media use has increased greatly over time in Cambodia

Facebook is one of the most widely used social media networks in Cambodia***

- 12,9 million people on Facebook (74,1% of the entire population and 86,3% of local internet user base)
- 44,4% female and 55,6% male

In February 2019, a nine year old girl died because of the cat bite

- A video of her shared on Facebook
- Many pictures and videos of hundred people who were bitten by animals sough to Rabies Center, Phnom Penh

Study Question:

What were the epidemiological attributes of Rabies PEP between pre-event and post-event?

Objective:

1) to use data at the Rabies Prevention Center of IPC in Phnom Penh recorded during 2017–2020 to examine the PEP uptake and patients' characteristics and
2) to understand how a social media event can affect the number of and the way people seek rabies PEP at IPC by comparing data before and after the event.

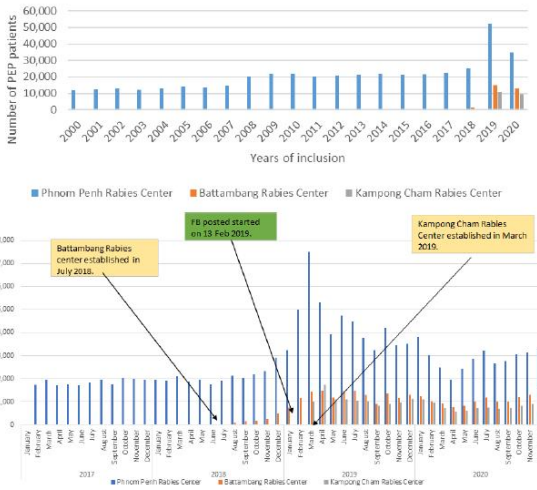
Methods:

Reviewed primary data collected by the Phnom Penh Rabies Prevention Center in Phnom Penh at IPC between 1 February 2017 and 31 December 2020

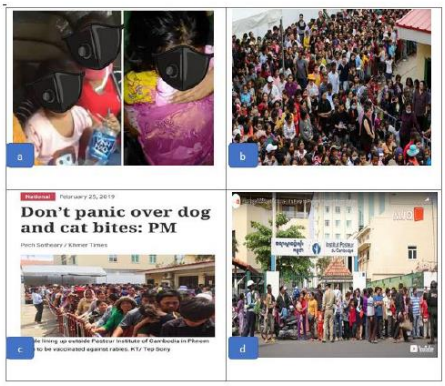
Conducted a search of social media postings to discover related relevant content.

***https://oosga.com/social-media/khm

Results after the event (1)

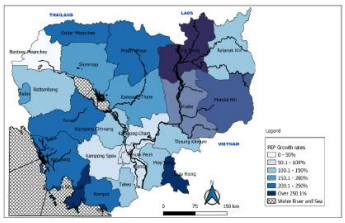


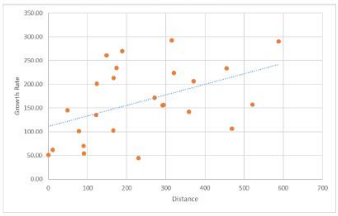
A summary of PEP patients at three Rabies Centres and a timeline of subsequent events.

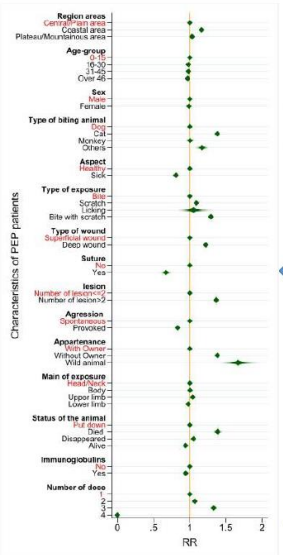


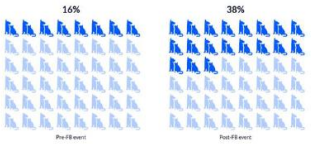
Results after the event (2)

Geographic distribution and a curve of the evolution of growth rate from 1 February 2017 to 31 December 2020, IPC, Cambodia (N=132,391)









Multivariate Poisson regression analysis of PEP characteristics associated with the relative risk (RR) of pre and post events.

Noted: Red is a reference

Conclusions

Rabies is a neglected disease & remains a public health concern in Cambodia

A social media event had a major impact on increasing rabies PEP uptake
Increased awareness and improved access for certain populations

- Living in remote areas from the PEP centre, cats,
- More healthy animals, Spontaneous, without ownership, adults

The event highlight a lack of knowledge of rabies in community

The use of social media to communicate evidence based public health messages may be beneficial in Cambodia

Limitations: Did not interviewer patients about social media potential over estimated results by panic, data only from Rabies Centre in Phnom Penh, exclude people that came but not receive PEP

Public health action is required to improve the uptake of knowledge of rabies in public, especially via social media and in relation to risk from cats

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Thank you for your attention!

Contact:
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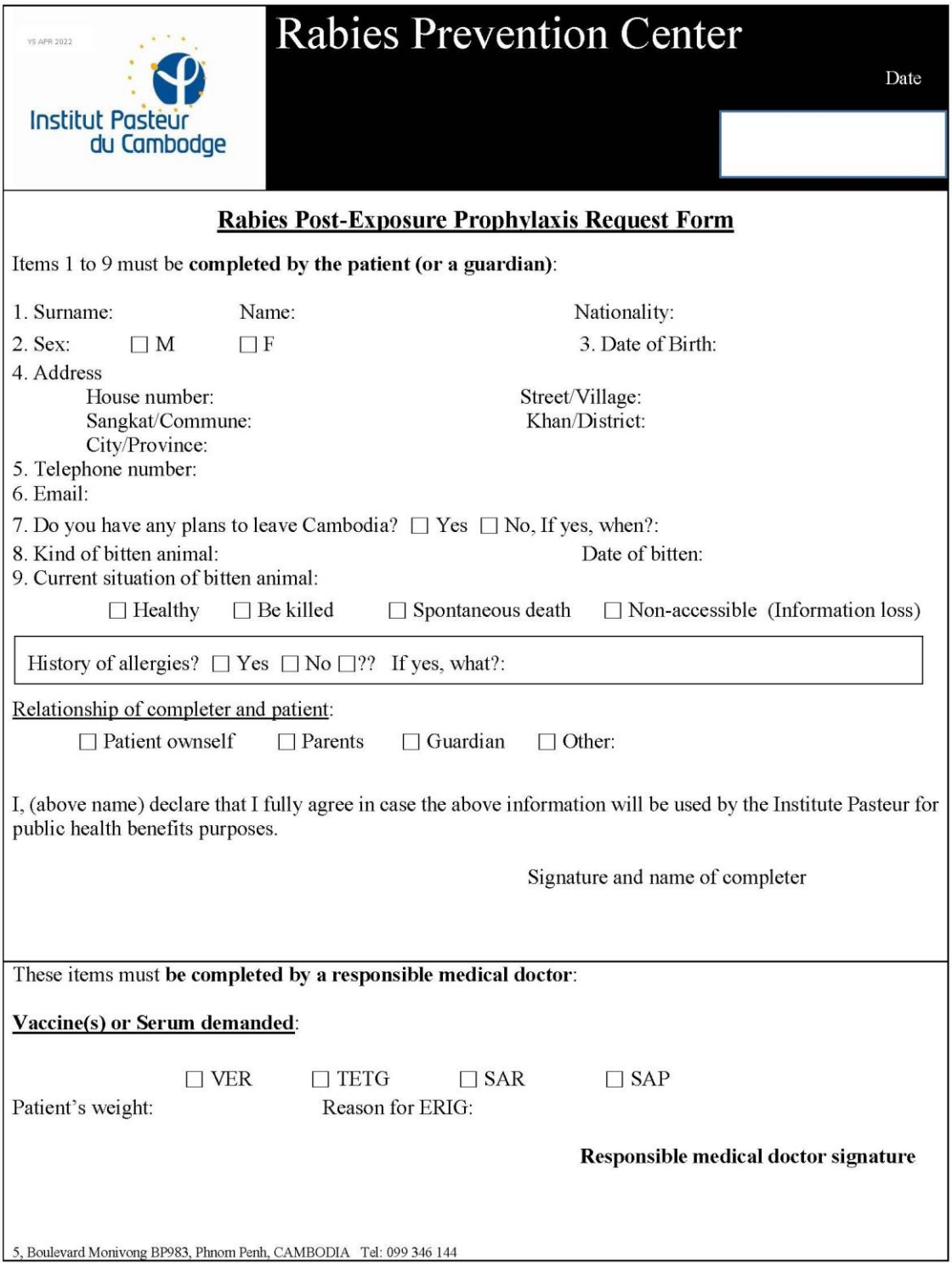
or malen@pasteur-kh.org

Appendix 2.3: Demographic Patient Form



Institut Pasteur du Cambodge

Rabies Prevention Center

Date

Rabies Post-Exposure Prophylaxis Request Form

Items 1 to 9 must be **completed by the patient (or a guardian)**:

1. Surname: Name: Nationality:
2. Sex: ☐ M ☐ F 3. Date of Birth:
4. Address
   House number: Street/Village:
   Sangkat/Commune: Khan/District:
   City/Province:
5. Telephone number:
6. Email:
7. Do you have any plans to leave Cambodia? ☐ Yes ☐ No, If yes, when?:
8. Kind of bitten animal: Date of bitten:
9. Current situation of bitten animal:
   ☐ Healthy ☐ Be killed ☐ Spontaneous death ☐ Non-accessible (Information loss)

History of allergies? ☐ Yes ☐ No ☐?? If yes, what?:

Relationship of completer and patient:

☐ Patient ownself ☐ Parents ☐ Guardian ☐ Other:

I, (above name) declare that I fully agree in case the above information will be used by the Institute Pasteur for public health benefits purposes.

Signature and name of completer

These items must **be completed by a responsible medical doctor**:

Vaccine(s) or Serum demanded:

☐ VER ☐ TETG ☐ SAR ☐ SAP

Patient's weight: Reason for ERIG:

Responsible medical doctor signature

5, Boulevard Monivong BP983, Phnom Penh, CAMBODIA Tel: 099 346 144

Appendix 2.4: Case Report Form of patient

INSTITUT PASTEUR DU CAMBODGE
RABIES PREVENTION CENTER

Sticker

Doctor _____

Patient

Sex 1[_] male 2[_] female
Pregnancy 1[_] yes 2[_] no
Trimester of pregnancy
1[_] 1st 2[_] 2nd 3[_] 3rd trimester
Age _____ year(s) or _____ month(s)
Nationality 1[_] Cambo. 2[_] foreigner
Telephone N. _____
Email _____
Travelling 1[_] yes 2[_] no
Exit from Cambodia on _____

Initial prescription:

wound care 1[_] yes 2[_] no
Anti-tetanus serum 1[_] yes 2[_] no
Tetanus vaccine 1[_] yes 2[_] no

Previously fully vaccinated against rabies
1[_] yes 2[_] no year _____
Anti-rabies serum 1[_] yes 2[_] no
Date _____ Weights _____ Kg
Reason 1[_] lab confirmed rabid animal
2[_] suspected animal
3[_] high-risk wound
4[_] other _____

Rabies vaccine 1[_] yes 2[_] no
If not given, reason _____

D3 Animal 1[_] was killed
2[_] death of illness
3[_] disappear/lose follow-up
4[_] accessible (healthy)
D7 Animal 1[_] was killed
2[_] death of illness
3[_] disappear/lose follow-up
4[_] accessible (healthy)

Characteristics of the accident

Date _____
Province _____
Mode of exposure
1[_] bite 2[_] scratch 3[_] lick
4[_] bite & scratch
5[_] contact with human rabies case
6[_] medical staff 7[_] PrEP
8[_] special demand
Surface 1[_] intact skin 2[_] non-intact skin
3[_] mucosa
Severity 1[_] superficial 2[_] deep wound
Bleeding 1[_] yes 2[_] no
Suture 1[_] yes 2[_] no
___ stitch(s) 1[_] partial 2[_] complete
Clothing interposition 1[_] yes 2[_] no
Number of wound(s) _____
Location of the main wounds
Loc- 1. _____
Loc- 2. _____
Loc- 3. _____

Characteristics of the animal and lab testing

Species 1[_] dog 2[_] cat 3[_] monkey
9[_] other _____
Agression 1[_] spontanous 2[_] provoke
Aspect 1[_] healthy 2[_] sick
Ownership 1[_] owned animal
2[_] stray animal
3[_] wild animal
Number of victim(s) _____
Status of animal 1[_] was killed
2[_] death of illness
3[_] disappear/lose follow-up
4[_] accessible (healthy)
Animal tested 1[_] yes 2[_] no
Relation to sample 1[_] index 2[_] secondary
ID code of index patient _____

(06-04-2023)

Appendix 2.5: Research summary for public

Can social media events influence patients to seek Rabies Post-exposure Prophylaxis at the Rabies Prevention Center?

Written by Ms Malen Chan, student of Master of Philosophy in Applied Epidemiology, Australian National University

Why did we need to do the study?

Although it can be prevented with a vaccine or with pre-exposure or post-exposure treatment (PEP). Rabies is still a big problem for Cambodia's public health. In February of 2019, a 10-year-old girl who had been bitten by a cat and was thought to have rabies and died. Her father posted a video to Facebook that showed how her symptoms got worse before she died. People in Cambodia use social media and like Facebook a lot. The video caused fear in the community, and thousands of people went to the Rabies Prevention Center of Institut Pasteur du Cambodge (IPC) in Phnom Penh to get rabies PEP. Since social factors can affect whether someone goes to the doctor, this study tried to figure out how this social media event affected the rabies PEP at IPC.

Who did we analyse in our study?

PEP patient who sought to the Rabies Prevention Center in Phnom Penh at IPC between February 2017 and December 2020.

How did we get the information?

We looked at the IPC PEP data for Phnom Penh from February 2017 to December 2020. We used a backwards search of social media and news postings for 2019 to find messages from the public that were important. We talked about and compared PEP data from two years before and two years after the post on social media about the child's death in order to find a link between rabies health seeking behaviours and knowledge.

What did we find?

During the study time, 132,391 people went to receive PEP: 48,623 before the social media event and 83,768 after, which is a 63.3% increase in uptake people who had experienced cat

bites animal scratches, and injuries from stray animals showed a high increase for accessing PEP after the social media event.

What could our research tell us?

Social media had a big effect on how people looked for information about rabies, especially after getting bitten by a cat. It is hard to keep track of and deal with knowledge from social media. Using social media to spread factual statements about public health and refuting misinformation could be helpful in Cambodia.

Khmer language translation

តើព្រឹត្តិការណ៍ប្រព័ន្ធផ្សព្វផ្សាយសង្គមអាចជះឥទ្ធិពលដល់អ្នកជំងឺក្នុងការស្វែងរកការបង្ការជំងឺឆ្កែឆ្កួតក្រោយការប៉ះពាល់នៅមជ្ឈមណ្ឌលបង្ការជំងឺឆ្កែឆ្កួតដែរឬទេ?

ហេតុអ្វីយើងត្រូវធ្វើការសិក្សា?

ទោះបីជា វាអាចត្រូវបានការពារដោយថ្នាំវ៉ាក់សាំង ឬជាមួយនឹងការព្យាបាលមុនការប៉ះពាល់ឬក្រោយ ពេលប៉ះពាល់ (PEP)។ ជំងឺឆ្កែឆ្កួត នៅតែជាបញ្ហាធំសម្រាប់សុខភាពសាធារណៈរបស់កម្ពុជា។ កាលពីខែកុម្ភៈ ឆ្នាំ 2019 ក្មេងស្រីអាយុ 10 ឆ្នាំម្នាក់ត្រូវបានឆ្មាខាំ ហើយត្រូវបានគេគិតថាមានជំងឺឆ្កែឆ្កួត ហើយបានស្លាប់។ ឪពុករបស់នាងបានបង្ហោះវីដេអូមួយក្នុងបណ្តាញសង្គម ហ្វេសប៊ុក ដែលបង្ហាញពីរោគសញ្ញារបស់នាងកាន់តែធ្ងន់ធ្ងរមុនពេលនាងស្លាប់។ ប្រជាជនកម្ពុជាប្រើប្រាស់បណ្តាញសង្គម និងចូលចិត្តប្រើហ្វេសប៊ុកច្រើន។ វីដេអូនេះ បានធ្វើឱ្យសហគមន៍មានការភ័យខ្លាច ហើយមនុស្សរាប់ពាន់នាក់បាន ទៅមជ្ឈមណ្ឌលបង្ការជំងឺឆ្កែឆ្កួតនៃវិទ្យាស្ថានប៉ាស្ទ័រកម្ពុជា(IPC)ក្នុងរាជធានីភ្នំពេញ ដើម្បីទទួលវ៉ាក់សាំងជំងឺឆ្កែឆ្កួតPEP ។ ដោយសារកត្តាសង្គម អាចប៉ះពាល់ដល់ថាតើនរណាម្នាក់ទៅជួបគ្រូពេទ្យ ការសិក្សានេះបានព្យាយាមរកឱ្យឃើញថា តើព្រឹត្តិការណ៍ ប្រព័ន្ធផ្សព្វផ្សាយ សង្គមនេះ បានប៉ះពាល់ដល់មជ្ឈមណ្ឌលបង្ការជំងឺឆ្កែឆ្កួត នៅ IPC យ៉ាងដូចម្តេច។

តើយើងបានវិភាគនរណាខ្លះ ក្នុងការសិក្សារបស់យើង?

អ្នកជម្ងឺបានចាក់PEP ដែលបានមកមជ្ឈមណ្ឌលបង្ការជំងឺឆ្កែឆ្កួតនៃវិទ្យាស្ថានប៉ាស្ទ័រកម្ពុជា ក្នុងរាជធានីភ្នំពេញ ចន្លោះខែកុម្ភៈ ឆ្នាំ ២០១៧ ដល់ខែធ្នូ ឆ្នាំ ២០២០។

តើយើងទទួលបានព័ត៌មានដោយរបៀបណា?

យើងបានពិនិត្យមើលទិន្នន័យ IPC PEP មជ្ឈមណ្ឌលបង្ការជំងឺឆ្កែឆ្កួតនៃវិទ្យាស្ថានប៉ាស្ទ័រកម្ពុជា ចាប់ពីខែកុម្ភៈ ឆ្នាំ 2017 ដល់ ខែធ្នូ ឆ្នាំ 2020។ យើងបានប្រើការស្វែងរកត្រឡប់ក្រោយនៃប្រព័ន្ធផ្សព្វផ្សាយសង្គម និងការបង្ហោះ ព័ត៌មាន សម្រាប់ឆ្នាំ 2019 ដើម្បីស្វែងរកសារពីសាធារណជន ដែលមានសារៈសំខាន់។ យើងបាននិយាយអំពី និងប្រៀបធៀបទិន្នន័យPEPពីពីរឆ្នាំមុន និង ពីរឆ្នាំបន្ទាប់ពី ការបង្ហោះ នៅលើប្រព័ន្ធផ្សព្វផ្សាយសង្គម អំពី ការស្លាប់របស់កុមារ ដើម្បីស្វែងរកទំនាក់ទំនងរវាងឥរិយាបថស្វែងរកសុខភាព និងចំណេះដឹង។

តើយើងបានរកឃើញអ្វី?

ក្នុងអំឡុងពេលសិក្សា មានចំនួនមនុស្ស132,391នាក់ បានទៅទទួលPEP: 48,623នាក់ មុនព្រឹត្តិការណ៍ ប្រព័ន្ធផ្សព្វផ្សាយសង្គម និង 83,768 បន្ទាប់ពីដែលជាការកើនឡើង ចំនួន63.3% នៃអ្នកដែលបាន ជួបប្រទះការកោសសត្វឆ្មាខាំ ហើយការរងរបួសពីសត្វរង្វេងបានបង្ហាញពីការកើនឡើងខ្ពស់សម្រាប់ការចូល។ PEP បន្ទាប់ពីព្រឹត្តិការណ៍ប្រព័ន្ធផ្សព្វផ្សាយសង្គម។

តើការស្រាវជ្រាវរបស់យើងអាចប្រាប់យើងអ្វីខ្លះ?

ប្រព័ន្ធផ្សព្វផ្សាយសង្គម មានឥទ្ធិពលយ៉ាងខ្លាំង ទៅលើរបៀបដែលមនុស្ស ស្វែងរកព័ត៌មាន អំពីជំងឺឆ្កែឆ្កួត ជាពិសេស បន្ទាប់ពីត្រូវបានឆ្មាខាំ។ វាពិបាក ក្នុងការតាមដាន និង ដោះស្រាយចំណេះដឹង ពីប្រព័ន្ធផ្សព្វផ្សាយសង្គម។ ការប្រើប្រាស់ប្រព័ន្ធផ្សព្វផ្សាយសង្គម ដើម្បីផ្សព្វផ្សាយ ការពិតអំពីសុខភាពសាធារណៈនិងការបដិសេធ ព័ត៌មាន មិនពិតអាចមានប្រយោជន៍ក្នុងប្រទេសកម្ពុជា។

Appendix 2.6: Review of Literature on Rabies

WHO and its partners have launched a global campaign to eliminate dog-mediated human rabies fatalities by 2030 (14). Vaccines against rabies are an essential component of the strategy to reduce the incidence of dog rabies, which is responsible for 98% of all human rabies fatalities worldwide (43). I undertook a scoping review of the available literature by searching PubMed using Boolean search terms alone or in combination including “Rabies” “social media,” “Rabies vaccine,” “Rabies post exposure prophylaxis.”

I looked for peer-reviewed studies on using Rabies data to assess impacts of intervention on rabies developments. In Appendix 2. 7 shows my initial search using the Patient, Intervention, Comparison, Outcome (PICO) structure (46,47).

Inclusion and exclusion criteria

Inclusion criteria were peer reviewed papers, published in English from 1914 to 2023 year which included the term “rabies prevention and control” and “Cambodia”. Papers that did not focus on Cambodia or rabies prevalence or control were excluded in **Error! Reference source not found.**.

Results of search

My initial search I included the terms “(Social Media) and/or (Rabies),” however there were no articles which found in the PubMed database. Using the terms “Rabies” “social media,” “Rabies vaccine,” “Rabies post exposure prophylaxis intervention and control” in **Error! Reference source not found.**.

Overall, 1,774 articles were found with this search strategy, when only articles published within the term of “Rabies Post Exposure Prophylaxis intervention and control” were considered, reducing the total number of articles to 239. The titles of all 239 articles were subsequently screened by me and 44 were selected for abstract reading and recording in Zotero. After the evaluating the abstracts, a further 24 articles were discarded. After reviewing the full texts of the remaining 20 articles, 12 were eliminated because they did not align with the scope of this literature review.

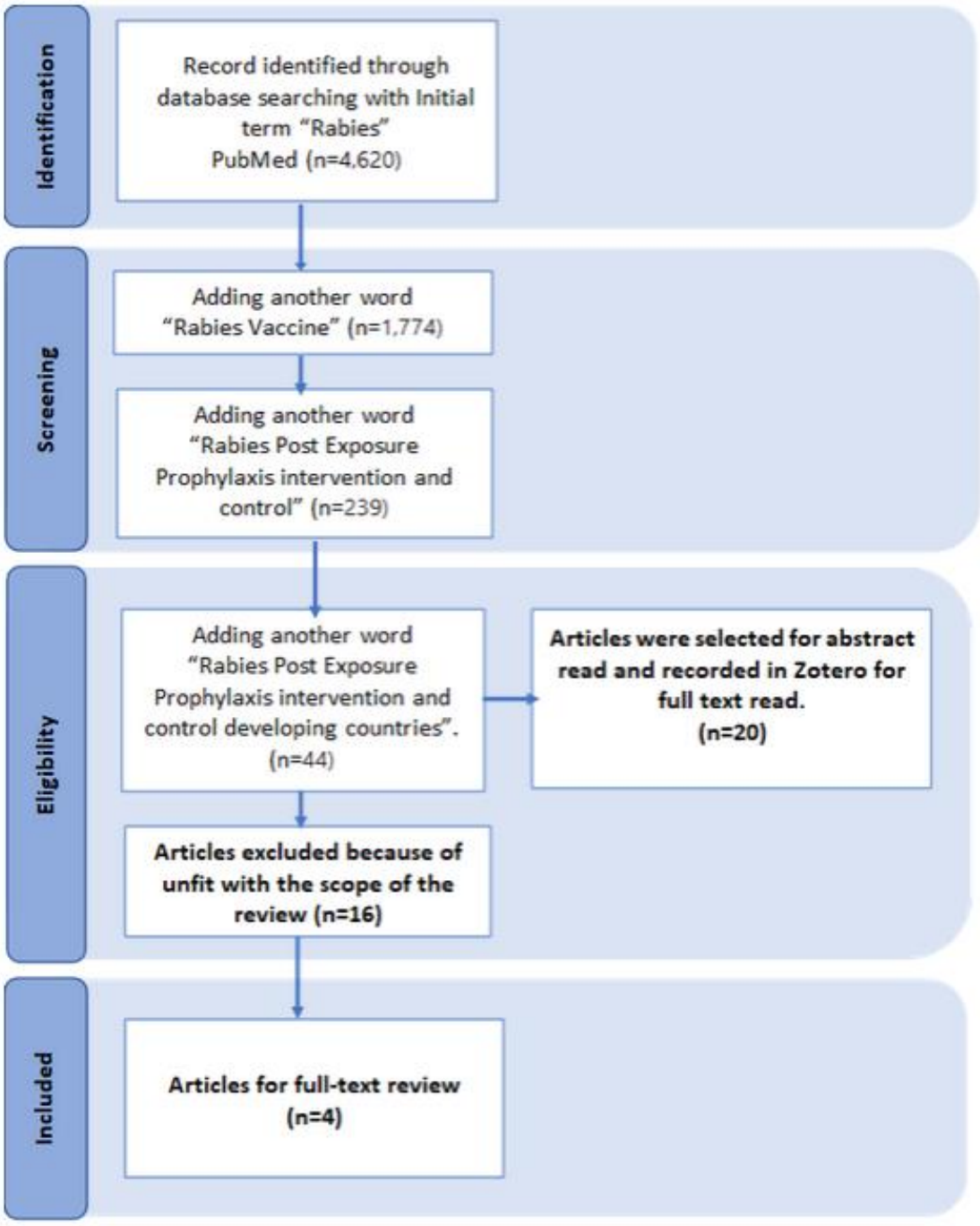
Four articles which were related to developing countries and Cambodia-related publications were selected for further analysis. These studies investigated the prevalence of rabies

exposures and injuries, the epidemiological characteristics of the people who sought PEP at rabies prevention centers in various countries (10,42,46), and additional rabies control and prevention (44).

Comparing rabies intervention and control measure Changalucha et al. 2018 and Qi et el. 2021 conducted the similar studies which focused on dog vaccination campaigns. Moreover, Changalucha et al. 2018 also included a comparison of the rate of the patients who received PEP for free of charge versus those who had to pay. In contrast, Kolarova-Dimitrova 2020 focused on post-injury treatment seekers, whereas Ly et al. 2009 investigated the PEP patient demographics from 1998 to 2007, and the 1,214 animal brain samples. This analysis revealed that 97% of all animal brain samples originated from dogs, a 49% (610) of the dog samples were rabies positive. Furthermore, Ly et al. 2009, used these PEP data in a statistical predictable model to project the national rabies-related human mortality rate for 2007. We noted that stray dogs caused the most injuries and the majority of those affected were urban residents.

Rabies is a series public health problem in Cambodia. Uptake of PEP is variable and community understanding of risk is minimal.

Appendix 2. 7. Diagram illustrating the Rabies scoping review.



Appendix 2. 8: Rabies Post Exposure Prophylaxis intervention and control and elimination rabies in 2030

"Title"Author, year	Objective	Study Design, country	Sample size	Intervention, comparing	Outcome
"The need to improve access to rabies post-exposure vaccines: Lessons from Tanzania." Changalucha et al., 2018	Examined the prevalence of rabies exposures and injuries for which patients sought treatment, as well as health seeking behaviours and health benefits in relation to PEP access.	Retrospective data analysis, Tanzania (East African)	5,168 (Contact tracing) 23,187 (Phone-based)	Dog vaccination campaigns Compared rate between the patients paid fee and unpaid for PEP Contact tracing (2002-2017) Phone-based (2011-2016)	Districts with lower human: dog ratios and urban centres had greater bite-injury rates. 25% of possible rabies exposures did not seek treatment owing to expense and fear of risk. Due to shortages, expense, 15% of likely rabies exposed people did not get PEP after seeking treatment. 46% of PEP incomplete injection.

"Epidemiological Characteristics of Post-exposure Prophylaxis of Rabies in Varna Region for the Period 2014-2018". Kolarova-Dimitrova, 2020	To investigate and analyse animal-related injuries and rabies post-exposure prophylaxis.	Retrospective epidemiological data analysis, Varna region	1462	Between 2014 and 2018, the research used official data from Varna's Regional Health Inspectorate (RHI) yearly report.	642 (42.7%) of 1462 post-injury treatment seekers needed emergency post-exposure prophylaxis. (91.8%) were urban residents. Stray dogs (58.14%) caused the most injuries, followed by domestic (37.41%) and wild (4.45%) animals.
Rabies Situation in Cambodia". Ly et al., 2009	(i) all post-exposure treated patients, (ii) Calmette hospital's human rabies cases, and (iii) human and animal specimens testing to define Cambodia's rabies epidemiology. Rural 2005–2007 surveys measured dog abundance and rabies vaccination coverage.	Retrospective data analysis, Cambodia	124749	PEP patients, human testing, and animal testing. We characterized a suspected rabid dog bite injury (SRDBI) in humans as a bite from an unprovoked dog that died spontaneously or was reported unwell. From the predicted prevalence of	95% from Phnom Penh (615 PEP/100,000) or five nearby provinces. The prediction model predicted 810 human rabies fatalities in 2007 (95% CI 394–1,607) at 5.8/100,000 (95% CI 2.8–11.5).

	Finally, we estimated Cambodian rabies-related human mortality from passively reported dog bite injuries using 2007 IPC data.			rabid dog bites, the body distribution of bite wounds, and PEP availability, they projected 2007 rabies human mortality countrywide using a deterministic probability model. (1998–2007)	
"Epidemiological characteristics and postexposure prophylaxis of human rabies in Chongqing, China, 2007–2016". Qi et el., 2021	Detailed the epidemiological characteristics and post-exposure prophylaxis (PEP) of human rabies in this area to provide an appropriate epidemiology basis for further control and prevention.	Retrospective rabies data analysis, China	809	Dog vaccination	Exposure and PEP status were reported by 548 rabies patients. Stray dogs caused 53.3% of human rabies cases. Domestic dogs had 4.0% infection. 548 human rabies cases went untreated. 548 cases did not receive timely, standardized PEP.

Abbreviation: PEP, Post Exposure Prophylaxis; SRDB, Suspected Rabid Dog Bite Injury; RHI, Reginal Health Inspect

Chapter 3: Epidemiological Study: Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID pandemic among live bird markets, 2022-2023

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Preface

Background:

I decided to conduct the Knowledge, Attitudes, and Practices (KAP) related to avian influenza (AI) among poultry workers in Live Bird Markets (LBMs) for this core competency because I have worked on LBMs for years. I have never conducted a KAP at an LBM. Furthermore, I am interested in understanding the impact of the COVID pandemic on the daily practices of poultry workers in the study's LBM markets, specifically in relation to their knowledge of avian influenza (KAP). We did not ask any questions related to COVID information or COVID immunisation during the survey; we compared times before, during, and after the COVID pandemic because of the Cambodian policy. The Australian National University (ANU) Human Research Ethics Committee (HREC) and the Cambodian National Ethics Committee for Health Research (NECHR) approved the research.

My role

- Selected and modified a suitable methodology
- Wrote the study protocol
- Obtained approval from National Ethics and the Australian National University Human Research Ethics Communities, and supporting documents for submitting to the local authorities in Cambodia
- Designed the questionnaire
- Piloted the draft of questionnaire for interviewing
- Gained permission from LBM market directors to conduct research
- Trained and supervised interviewers
- Analysed data quantitative and qualitative
- Interpreted findings
- Drafted report

Lessons learned

I gained several insights from being involved in the research.

1. Submitting the protocol and adapting both local and international context to apply for both environments was challenging. For greatest benefit, study results should be generated as quickly as feasible. I submitted a protocol for expedited review to the ethical committees of both Cambodia and Australian National University (ANU). I received an approval from Cambodian committee quickly after submitting. However, the ethical committee at ANU referred my protocol to the full board for consideration, which took a month to approve. I was unable to immediately begin the study after receiving approval because I had to deal with other duties and there were some public holidays in Cambodia. Finally, after seven months. I produced results.

2. The collection of qualitative data with a modest sample size of 100 can generate reliable results. In a career in applied epidemiology, it may be necessary to present findings from a study with a small sample size, which makes generalization and statistical inference challenging. By incorporating qualitative information, we can provide context for the findings.

3. Conducting phone-interviews: In the markets, the workers were busy making it challenging to complete all interviews face to face. Our team had to wait for our respondents to become available. We did not want to interfere with their work. I requested the interviewers to obtain consent from our respondents in advance, when they were too busy to be interviewed at work, and then I phoned them in the late afternoon.

Public health impact

This information will be useful to improve understanding and guide training and health promotion actions in live bird markets. These need to promote changes in knowledge, attitudes, and behaviors, as well as law and regulation, to protect, maintain, and poultry workers. This information may lead to improved Live Bird Markets (LBMs) self-prevention.

Acknowledgements

During a very hectic period of busy time, we appreciate the participants' generosity in sharing their time and stories both face-to-face and phone-interviews. Your accomplishments and impact on your communities are remarkable, and I appreciate your permission to compile and share your stories.

Dr. Erik Karlsson, Deputy of the Virology Unit, is thanked for supporting me in assessing the Food and Agriculture Organization (FAO) budget as part of my Master of Philosophy in Applied Epidemiology (MAE) competency.

I am indebted to all my supervisors- Dr. Samantha Colquhoun, Dr. Sowath Ly, Dr. Claude Flamand and Dr. Erik Karlsson – for their kindness and insightful feedback throughout the study design and composition phases. You have devoted your time to my cause from the beginning. Additionally, Frida E Sparaciari, a PhD scholar who supported and provided feedback in writing processing.

Funding

Food and Agriculture Organization (FAO).

Abstract

Background

Avian influenza (AI) presents an immense risk to global public health. In January 2004, the first verified epidemic of highly pathogenic avian influenza virus subtype H5N1 was reported in Cambodia and a major public health concern. It is important to keep poultry workers adequately informed and educated about how to avoid or reduce exposure to AI for the effective prevention and control of AI. The purpose of the survey was to assess the level of AI safety related knowledge, attitudes, and practices (KAPs) among poultry workers in three live bird markets (LBMs) where poultry was being actively traded and to examine the relationship between KAPs and factors associated with the control and prevention of AIVs. In addition, we aimed to investigate if there had been a reduction in safe handling practices as a result of the COVID-19 pandemic.

Methods

A KAP survey was designed based on poultry workers' knowledge, attitudes, and practice. LBM poultry workers were approached for consent to participate. Interviews were conducted face-to-face and phone interview, if the participant was too busy to take part during market

opening hours. Poultry workers selected from Orussey, Chbar Ampov (Phnom Penh city) and Takeo (Takeo province) markets, respectively. These were the most active markets for live poultry in Cambodia. All the participants were voluntarily responded to the questionnaire. This cohort included 37 respondents from the Orussey market, 23 individuals from the Chbar Ampov market, and 40 individuals from the Takeo market, and 50 men and women aged 18–68 participated. The Knowledge, Attitudes, and Practices (KAP) scores were computed. The variables KAP was evaluated by using the use of Chi-squared and Fisher exact tests for comparison, and a descriptive analysis of the data was carried out as well.

Results

The study included 100 individuals' poultry workers, with an equal distribution of males and females. The median age of the participants was determined to be 39.6 years. There were no association between the knowledge, attitude, and practices of poultry workers on avian influenza before and during the COVID-19 pandemic, no connections.

Conclusion

The findings have contributed to a better comprehension of the knowledge, attitudes, and perceptions of poultry workers in three Cambodian markets regarding the prevention of AIVs by providing new insights. Improving wearing equipment during working with poultry is significant to reduce the risk of AIVs. Informed by the results, directed public health activities will be able to concentrate on enhancing control and risk mitigation efforts. By disseminating the study's findings to poultry workers, local authorities, and national and international organizations, it will be possible to implement targeted interventions and conduct additional research to increase knowledge and reduce infection and transmission risk.

Abbreviations

AI	Avian influenza
AIVs	Avian influenza viruses
ANU	Australian National University
FAO	Food and Agriculture Organization
HPAI	Highly pathogenic avian influenza
HREC	Human Research Ethics Committee
IPC	Institut Pasteur du Cambodge
KAP	Knowledge, attitudes, and practices
LBM	Live bird market
NECHR	National Ethics Committee for Health Research

3.0 Introduction

In 1997, the Hong Kong Special Administrative Region reported the first incidence of animal-to-human transmission, when the highly pathogenic avian influenza (HPAI) A(H5N1) virus was transmitted to humans (1,2). Avian Influenza Virus (AIVs) are highly transmittable between domestic and wild birds, it can rarely affect people, though there is no evidence that the disease has yet acquired the ability to spread from person to person (3,4). The bird-to-human transmission can be transmitted through direct contact between an infected bird via the human's eyes, nose, or mouth, or inhalation (5). According to available epidemiological data, humans are primarily infected with avian influenza A(H5N1) via poultry (6). Whenever avian influenza viruses are circulating in poultry, there is a risk for sporadic infection or small clusters of human cases due to exposure to infected poultry or contaminated environments (7).

Live Bird Markets (LBMs) are a significant risk factor for virus replication, persistence, amplification, and dissemination of avian influenza viruses (8). In Cambodia, LBMs play a significant role in the poultry supply chain (9), nevertheless, LBMs have been documented in a consistent pattern of AIVs circulation, with peak viral activity occurring during festival periods. Especially during the actions of slaughtering or processing poultry. Another study held in Cambodia demonstrated high levels of AIVs reported to be circulating with 30%–50% of ducks and 20%–40% of poultry testing positive for AIVs (10,11). Hence, safe handling, surveillance and mitigation strategies are vitally important to lessen the incidence of AIVs in LBMs (12).

The transportation of poultry within markets has a significant role in the dissemination and transmission of highly pathogenic avian influenza. There is less knowledge regarding the poultry market chains in Cambodia. Direct trade connections with Thailand and Vietnam were established through middlemen and local sellers. The majority of poultry transportation occurs by middlemen, leading to the concentration of live bird wet markets in Phnom Penh. Consequently, these markets have the potential to serve as a central location for the dissemination of H5N1 and are therefore well-suited for surveillance and control measures (13).

Poultry workers are at high risk of avian influenza infection due to direct contact with infected birds or their body fluids (14). A study in China illustrated that nearly half of the poultry workers failed to recognize contact with sick birds or excrement as a risk of avian influenza infection (15). In addition, the participants answered a survey where the results demonstrated that

poultry workers did not pay sufficient attention to wearing preventive clothing such as gloves (43.1%), aprons (33.3%) and face masks (26.9%) when handling live poultry. Few respondents were supportive of market control measures such as a ban on birds' overnight storage (26.8%) or a regular rest day (32.4%) (16). In Cambodia, a case of Avian influenza A(H9N2) in Siem Reap, where an infected child who lives in an agrarian village had close contact with small-scale backyard poultry in child's residences, the outcome was that a Health education on safe poultry farming practices was provided from authorities to families with close contact with animals (17).

On 30 January 2020, the Director General of the World Health Organization (WHO) declared that the COVID-19 outbreak constitutes a Public Health Emergency of International Concern (18). Following the situation, Cambodia recorded a first case of COVID-19 on January 27, 2020 (19). Then, the Cambodian government confirmed occasional citywide lockdowns beginning, where large scale physical distancing measures and movement restrictions are in place to limit the contact between people, such as, schools, business, traditional food market, and other (20). On November 2021, Cambodia fully reopened the country (21) before the WHO announced on 5 May 2023 that the COVID-19 virus is no longer a public health emergency (22). In response to its catastrophic impact on public health, global health brings more attention to zoonotic diseases, especially AIVs (2).

The Institut Pasteur du Cambodge (IPC) has undertaken research over many years in AIVs risk factors in Cambodian poultry markets and has a close working relationship with the markets, day to day observation has suggested that if safety issues can be identified then targeted public health policy and training could be implemented to mitigate ongoing risk of AIVs transmission. However, the available information regarding the safe handling of poultry-by-poultry workers in LBMs is minimal while this information is crucial to address the risk of AIVs.

Objectives:

The objectives of this study were:

(1) to compare the knowledge, attitudes, and practices of poultry workers in three Cambodian markets.

(2) to understand the impact of the COVID-19 pandemic on AIV (avian influenza viruses) risk factors.

3.1 Methods

Study design and participants

We conducted a cross-sectional study on KAP at three live poultry markets: Orussey and Chbar Ampov markets in Phnom Penh, and Takeo market in Takeo province. The research was conducted on a sample of 100 markets where poultry workers have worked. The resulted in a sample size of 100 poultry workers which included poultry sellers, slaughterers, middleman and transporters from these three markets. The participants ranging in age from 18 to 68 years. After obtaining informed written consent a standardized questionnaire was delivered by interviewers to collect information related knowledge, attitude, and avian influenza practices from the poultry workers about their routine practices of poultry handling during the time of the COVID-19 pandemic.

The four main roles of poultry workers who were approached to participate were:

- Poultry seller: a person who sells or works at the LBMs and is not included in one of the three other role categories.
- Slaughterer: a person who slaughters live poultry for human consumption at the LBMs
- Middleman: a person who buys live poultry from the markets and sell to other places
- Transporter: a person who transports live poultry to other locations to and from the markets.

Figure 3. 1 illustrates the locations of the three distinct LBM sites. The markets selected for inclusion in the study: Orussey Market and Chbar Ampov Markets, Phnom Penh, and Takeo Market in Takeo province varied in size of stallholders and location, with Orussey Market in PP being the largest. All markets operated in a comparable manner, receiving poultry from different regional areas of Cambodia, and selling live and slaughtered poultry.

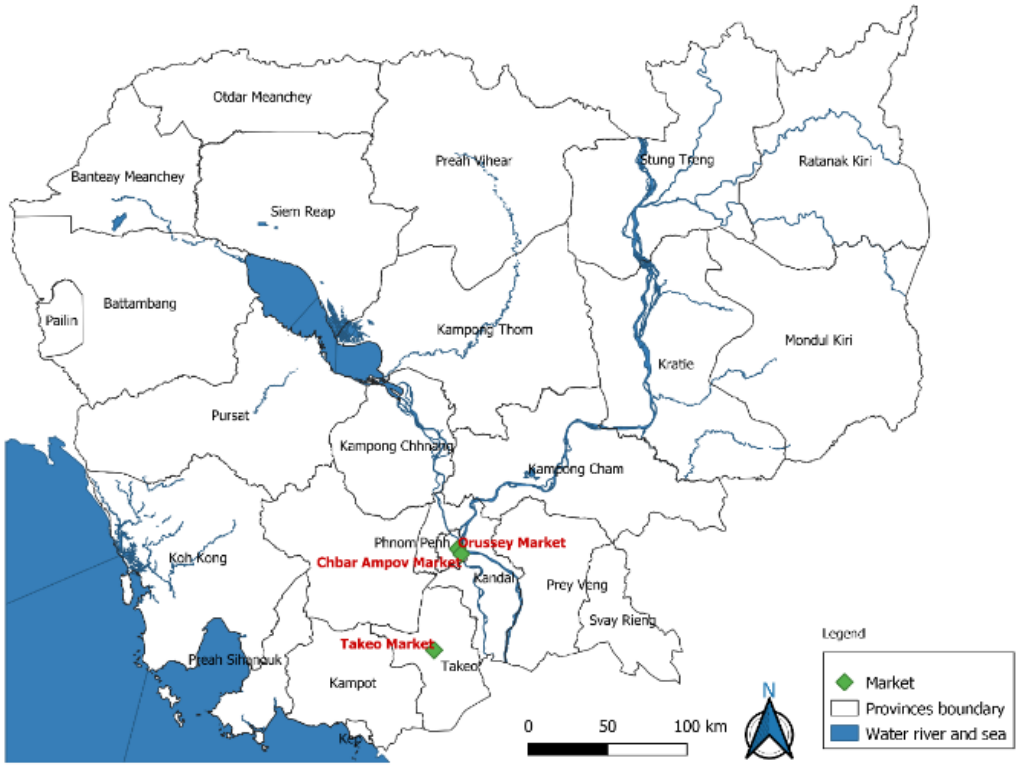

Figure 3. 1. Cambodian map depicting locations of selected live bird markets in Cambodia

Data Collection or Survey Methodology

We conducted the field work between December 2022 and January 13, 2023. During this period, we surveyed three markets: one in Takeo and two in Phnom Penh. We developed a structured questionnaire (Appendix 3.1) that covered four key areas of questions: 1. demographic information of the respondents; 2. knowledge of AI and its source of transmission; 3. attitudes toward AIVs; and 4. practices for AI prevention. We translated each session of the questionnaire from English to Khmer and then made modifications based on feedback and comments from colleagues and supervisors. We used a pre-test questionnaire to assess the validity and reliability of the data.

We collected demographic information on age, gender, education, poultry worker role, years of working, monthly income, and KAP associated with avian influenza. Each interview lasted thirty minutes. Most queries were closed-ended, requiring respondents to choose from an established list of answers (Yes/No/Don't Know). Aside from age, which was documented as a continuous variable, the majority of variables derived from these queries were categorical.

We asked participants about their behavior before and during the COVID-19 pandemic and evaluated KAPs associated with avian influenza. As there were no baseline data available, we asked participants to comment on their practices pre- and during the COVID-19 pandemic, noting the limitation that recall bias may provide a confounding issue.

Data was collected on paper case report forms in and then entered in a RedCap database. The questionnaire data were checked for validation to check for questionnaire completeness and interviewer data input errors prior to entry into RedCap software. The investigator provided interviewers with instructions on the use of the questionnaire, information sheet and consent form prior to conducting the survey. Only experienced interviewers were used. Each questionnaire consisted of 45 questions divided into two sections which included: personal information, knowledge of rabies, attitudes regarding avian influenza, and behaviour related to safe handling of poultry prior to and during the current the COVID-19 pandemic. Multiple responses were permitted for open-ended questions.

Statistical analysis

After ensuring consistency, we exported the data into STATA 18 (Stata Corp., Texas, United States) software for analysis. We conducted descriptive analyses for each variable in the modules of social demographics, knowledge, attitude, and practice. We also allocated scores to each question.

The Methods section above assigned a scale based on the participant's knowledge of AIVs, attitudes, and practices for preventing the transmission of AIVs, which determined their scores. The scores depended on the questions; the number of correct responses determined the participant’s KAP. We computed the KAP score by adding the correct responses to ten questions about potential transmission routes, followed by three questions about attitudes and three questions about practices for preventing avian influenza. We calculated a practice score by adding the number of preventative measures using a three-item practice evaluation.

Participants were considered to have poor KAP if their KAP score for all KAP questions were greater than the sample median KAP score. A Chi-Square analysis was used to assess the relationship and difference between variables. In addition, a t-test was used to compare the scores of the two groups (before and during COVID-19) using independent samples (See supplementary (Appendix 3.2). All test of hypotheses were two-sided.

Procedure and ethical considerations

The Committee on Research Ethics in Cambodia granted ethics approval for the KAP study research on November 3, 2022, and the Human Research Ethics Committee at the Australian National University endorsed the study protocol (2022/669). Before each interview, each participant provided verbal, informed consent. We avoided peak sales hours to ensure high-quality interviews.

We requested permission to conduct research in the three markets by submitting letters to the Phnom Penh municipality and the Takeo city hall informing them of the date of our fieldwork at the selected markets. After obtaining approval letters from Phnom Penh and Takeo municipalities, we then verbally notified the local authorities in each market. The research team coordinated with the vet officers and authorities at the markets. Because of the ongoing risk from COVID-19, the research team complied with Cambodian government regulations when interviewing in each study setting.

3.2 Results

Participant demographics

Demographic characteristics of poultry workers at three LBMs are demonstrated in Table 3. 1. Demographics characteristics of poultry workers at three live bird markets, Cambodia (n=100). A total of 100 participants provided consent to participate in the project this included n=37 from Orussey Market, n=23 from the Chbar Ampov Market, and n=40 from Takeo Market. The study population consisted of an equal number of males and females. The ages of the participants ranged from 18 to 68 years old, with a median age was 39.64 years, and 57% of the population was between the ages of 18 and 43. Education levels of the participants varied respondents 9% had not attended formal schooling, 7% had non-formal education, 35% had completed primary school, 40 % had completed secondary school. Seventy percent of respondents were business owners and 72% of respondents were sellers, while only 8% were middlemen and transporters. The largest group (49%) had more than ten years of professional experience working in poultry markets, while 26% had less than six years. Most (70%) poultry workers had stopped their work during the peak COVID-19 pandemic in Cambodia.

Table 3. 1. Demographics characteristics of poultry workers at three live bird markets, Cambodia (n=100)

Demographics	**N**	**%**
Gender		
Male	50	50
Female	50	50
Age group		
18-43	57	57
44-58	36	36
≥59	7	7
Education		
No schooling	9	9.0
Non-formal education	7	7.0
Primary school	35	35.0
Secondary school	40	40.0
Degree level/high school	6	6.0
College/University and above	3	3.0
Market		
Orussey Market	37	37.0
Takeo Market	40	40.0
Chbar Ampov Market	23	23.0
Job status		
Owner of the business	70	70.0
Worker	30	30.0
Type of work in the market[a]		
Poultry Seller	72	72.0
Slaughter	20	20.0
Middleman	5	5.0
Transporter	3	3.0
Years of work in Live Bird Market		
<1 year	7	7.0
2-5 years	19	19.0
6-10 years	25	25.0
Above 10 years	49	49.0
Did you stop working during COVID pandemic?		
No	30	30.0
Yes	70	70.0

[a] All these four main roles have direct contact with poultry.

General information about the participants

The participants were asked to report and reflect on their general information, before and during the COVID-19 pandemic work (Table 3. 2). During the COVID-19 pandemic, we discovered a significant increase in the proportion of respondents with a monthly income of less than $350, from 44.1% to 52%, while the proportion of respondents with a monthly income of more than $1000 decreased from 16.1% to 3.0%. Forty seven percent of poultry workers had a daily average hour of contact with poultry, 90.0% of poultry workers did not get the flu vaccination during the COVID-19 pandemic, and the proportion of respondents who attended/participated in communication events regarding avian influenza decreased between 30% and 10%.

Poultry workers who experienced symptoms of fever, sneezing, and coughing responded their preference is to go to the pharmacy, 41.0% before and 35.0% during COVID-19. In contrast, the frequency of other activities was far lower, specifically among individuals who lacked knowledge (Do not know), with a mere 2.0% participation rate.

Table 3. 2. General information prior to COVID-19 and the during the COVID-19 pandemic of poultry workers in three Cambodian LBMs, Cambodia (n=100)

Characteristic	Before the COVID pandemic (n=100)		Current Situation (n=100)	
	N	%	N	%
Monthly personal income*				
Under 350 $	**41**	**44.1**	**52**	**52.0**
350 to 600$	**26**	**28.0**	**30**	**30.0**
601 to 1000$	11	11.8	15	15.0
Above 1000$	15	16.1	3	3.0
Daily average hours of contact with live poultry*				
<8	**36**	**38.7**	**39**	**39.0**
8-10	**13**	**14.0**	**15**	**15.0**
>10	**44**	**47.3**	**46**	**46.0**
Have you injected flu vaccine?				
No	**78**	**78.0**	**90**	**90.0**
Yes	20	20.0	9	9.0
Do not know	2	2.0	1	1.0
Have you heard about antibiotic resistant?				
No	88	88.0	88	88.0
Yes	7	7.0	7	7.0
Do not know	5	5.0	5	5.0
Are you interested in a flu vaccine?				
No	46	46.0	46	46.0
Yes	47	47.0	49	47.0
Do not know	7	7.0	5	7.0
Have you ever attended any training/communication events on influenza virus?				
No	**69**	**69.0**	**89**	**89.0**
Yes	30	30.0	10	10.0
Do not know	1	1.0	1	1.0
What will you do if you are sick with fever, sneeze, and cough?				
Nothing	**18**	**18.0**	**22**	**22.0**
Buy medicine by myself	17	17.0	14	14.0
Go to pharmacy	41	41.0	35	35.0
Private clinic	**16**	**16.0**	**19**	**19.0**
Public hospital	**5**	**5.0**	**8**	**8.0**
Do not know	3	3.0	2	2.0

*Missing because poultry workers have worked less than 1 year and (n=93)

2. Participants knowledge and experiences of Avian Influenza

Knowledge of poultry workers before and during COVID-19 is shown in Table 3.3. A significant shift in awareness was evident, with a considerably higher percentage of respondents having heard about Avian influenza during the COVID pandemic (59.0%) compared to the before COVID period (81.0%), while the number of individuals who were unaware of it increased from 15.0% before to 41.0% during the pandemic. Other knowledge of respondents on AI before the COVID pandemic, it was highlighted that when it comes to seeking information, the participants preferred sources friends/relatives emerged as the top choice, with 25% participants relying on their personal networks to gather information. Next were veterinary officers, cited by 24% individuals as a trusted source. Television played a key role as well, with 19% respondents turning to this traditional medium for information. Leaflets and booklets were used by eight participants to acquire knowledge. Social media was a lesser preference, mentioned by five respondents. On the other hand, 41% of people were unaware of or did not know about the sources of AI information during the COVID epidemic.

Questions related to the perceived seriousness and preventability of AI showed no significant differences between the two-time frames, with the majority of respondents (52 respondents) believing it to be a serious disease (both before and during the pandemic) and that it could be prevented. Similarly, concerns about family and friends contracting bird flu did not exhibit variation between the two periods.

Table 3. 3. Poultry workers knowledge prior to and during the COVID-19 pandemic (n=100)

Characteristic	Before the COVID pandemic (n=100)		Current Situation (n=100)	
	N	%	N	%
Have your heard about Avian influenza				
No	**15**	**15.0**	**41**	**41.0**
Yes	81	81.0	59	59.0
Don't know	4	4.0	0	0.0
Source of Information				
Social media	**5**	**5.0**	**11**	**11.0**
Television	19	19.0	8	8.0
Leaflets/booklets	8	8.0	8	8.0
Friends/relatives	25	25.0	15	15.0
Vet officers	24	24.0	17	17.0
No/Do not know	**19**	**19.0**	**41**	**41.0**
With infected human				
No	**13**	**13.0**	**18**	**18.0**
Yes	61	61.0	57	57.0
Don't know	26	26.0	25	25.0
With infected poultry				
No	**14**	**14.0**	**22**	**22.0**
Yes	62	62.0	57	57.0
Don't know	24	24.0	21	21.0
With cages of infected poultry				
No	**26**	**26.0**	**31**	**31.0**
Yes	50	50.0	47	47.0
Don't know	24	24.0	22	22.0
Through water of infected poultry?				
No	**20**	**20.0**	**22**	**22.0**
Yes	48	48.0	46	46.0
Don't know	32	32.0	32	32.0
Through air				
No	23	23.0	29	29.0
Yes	45	45.0	42	42.0
Don't know	32	32.0	29	29.0
Avian influenza is serious disease?				
No	23	23.0	31	31.0
Yes	59	59.0	52	52.0
Not sure	18	18.0	17	17.0
Avian influenza can prevent?				
No	6	6.0	6	6.0
Yes	**82**	**82.0**	**86**	**86.0**
Not sure	12	12.0	8	8.0
Do you worry about your family/friends getting bird flu?				
No	**27**	**27.0**	**28**	**28.0**
Yes	**67**	**67.0**	**69**	**69.0**
Not sure	6	6.0	3	3.0

Participant's attitudes towards Avian Influenza

Questions about the attitudes of poultry workers were asked at the time of the interview. They were asked to reflect on their attitude both before and during the COVID pandemic. These data are presented in Table 3. 4. During the pandemic, 55% of individuals employed as poultry workers indicated an interest in additional knowledge regarding AIVs, while a majority of 67 % expressed concerns over the potential outbreak of Avian Influenza Viruses (AIVs) in the future. A considerable proportion, around 30% of poultry workers expressed no concern regarding the risk of contracting AIV. Meanwhile, when poultry workers were asked if they were worried about becoming infected with avian influenza, about 30% said that before and during COVID they were not worried, a similar proportion said they were extremely worried, while 20% reported no worries about AVI infection while working with poultry before and during COVID-19.

Table 3. 4. Attitudes of poultry workers prior to and during COVID-19 pandemic (n=100)

Characteristic	Before the COVID pandemic (n=100)		Current Situation (n=100)	
Attitudes	N	%	N	%
Do you want to know more about avian influenza?				
No	45	45.0	44	44.0
Yes	**53**	**53.0**	**55**	**55.0**
Do not know	2	2.0	1	1.0
Are you concerned about Avian influenza outbreak in the future?				
No	33	33.0	30	30.0
Yes	**65**	**65.0**	**67**	**67.0**
Do not know	2	2.0	3	3.0
Do you worry of getting infected by avian influenza? (e.g., 1=Not worried, 3= Note Sure, 5=Extremely worried)				
1	**20**	**20.0**	**21**	**21.0**
2	6	6.0	7	7.0
3	33	33.0	25	25.0
4	**10**	**10.0**	**17**	**17.0**
5	31	31.0	30	30.0

Participants reported practices for prevention of Avian Influenza (AI)

The results of the practice related questions asked to the poultry workers (Table 3. 5) provided an information on various practices related to poultry handling, hand hygiene, and the use of personal protective equipment (PPE) before and during the COVID-19 pandemic. Notably,

there was an increase in the percentage of individuals who did not touch sick or dead poultry by hands during the COVID-19 pandemic (77.0%) compared to before (71.0%). When it comes to hand hygiene after touching poultry, there was slightly changes, with individuals using soap or hand sanitizer.

Regarding the use of PPE, the use of face masks declined during the COVID-19 pandemic (36.7%) compared to before (55.8%). However, there was an increase in the percentage of individuals who did not use any protective equipment during the pandemic (45.0%) compared to before (20.2%), suggesting a potential shift in PPE practices during the pandemic. The use of gloves and boots remained relatively consistent. Overall, this data provides insights into how certain practices related to poultry handling and PPE usage evolved during the COVID-19 pandemic.

Table 3. 5. Practices of poultry workers prior to and during COVID-19 pandemic (n=100)

	Before the COVID pandemic (n=100)		**Current Situation (n=100)**	
Practices	N	%	N	%
Do you touch sick or dead poultry by hands? *				
No	**66**	**71.0**	**77**	**77.0**
Yes	27	29.0	23	23.0
After touching poultry, wash hands? *				
Use soap or hand sanitizer	**49**	**52.7**	**56**	**56.0**
Clean with water	40	43.0	39	39.0
Nothing	4	4.3	5	5.0
When you are working, do you wear: **				
Gloves	13	12.5	9	8.3
Boots	9	8.7	9	8.3
Apron	3	2.9	2	1.8
Face mask	**58**	**55.8**	**40**	**36.7**
No	**21**	**20.2**	**49**	**45.0**

*Missing because of the people worked for a duration of less than one year (n=93);**Multiple choice

Perception data for poultry workers on AIV

The poultry workers were asked for additional free text information to allow for further qualitative assessment. We categorized and presented their responses to the free text questions summarised and presented in Appendix 3.3.

Poultry originating from different areas in Cambodia were available for sale at the three Live Bird Markets (LBMs). Poultry workers expressed interest in AIV. Participants were quoted as stating:

"I am interested in obtaining knowledge regarding the symptoms presented by AI in the event of infection, as well as effective preventive measures. This is of particular importance to me as self-prevention is crucial when engaging in poultry-related activities",

"I am interested in understanding ways of preventing the risk of infectious AIVs because I sell every day" and;

"I am interested in understanding the ways via which AIVs is transmitted to humans."

Poultry workers had a strong interest in AI due to their belief that obtaining knowledge about the risk factors associated with AI could enable them to proactively safeguard themselves against potential viruses.

Prevention and control of AI

Based on the findings, many poultry workers consistently use hand sanitizer and took part in hand hygiene practices as a way of killing bacteria and viruses. Additionally, they reported that they undertook this measure as a way of preventing them from the risk of contracting COVID-19. Some poultry workers said that *"I use a hand disinfectant for COVID-19 prevention.*" and others said, *"I use hand sanitizer for influenza and COVID-19 prevention."*

3.3 Discussion

Our study emphasises the critical role of KAP among poultry workers in the transmission dynamics of AI within Cambodia's LBMs. This study provides an understanding of the risks associated with AI and how poultry workers still have limited practice to prevent illness based on the data provided by respondents. The markets were chosen because Live bird markets

(LBMs) in Asia are a crucial factor into the persistence of avian influenza viruses in the region and a likely source of many reassorting viruses (11). Overall, this data provides insights into how certain practices related to poultry handling and PPE usage evolved during the COVID-19 pandemic.

Furthermore, human infections with pandemic concern AIVs have been linked to these settings (12). Many types of birds access these markets via the poultry value chain, which includes backyard and semicommercial farmers.

Basic information on market type and location could be readily gathered from each LBM to facilitate the identification of markets with an elevated risk of infection maintenance, where risk mitigation strategies should be implemented (8). This high degree of self-reported knowledge and preventive practices regarding AI might be the result of the availability of information for representing the active markets in Cambodia.

Participant demographics and general information

In our study, we noticed that the cost of providing and maintaining protective equipment was an important barrier for poultry workers, particularly in small-scale business settings where profit margin may already be low. Most of the participants had an income under the US$350 before and during COVID-19. According to the responses provided by the participants, they are required to purchase their own protective equipment, including gloves (US$9 per box), boots (US$3), aprons (US$3.2), and face masks (US$1.5 per box), resulting in a total cost of US$16.7. This implies that approximately 5% of their income is allocated towards purchasing PPE. Consequently, this information is important for the local authorities who could allocate funds and invest in ensuring that PPEs are provided to these poultry workers. The study held by *Liang et al.*, in China, revealed that the implementation of preventative measures in LBMs may result in losses, including time, financial resources, and economic failures such expenses might potentially discourage sellers from changing their behaviour (23). The study revealed that the majority of poultry workers are in direct contact with poultry for more than 10 hours a day and do not wear adequately specialized PPE to protect themselves from AIVs.

Most of the poultry workers wear only aprons or waterproof shoes, placing them at an elevated risk of exposure to AIVs. The appropriate use of PPE is crucial; however, it is worth noting that PPE can be uncomfortable and cause excessive heat, leading to its infrequent use in practical situations. An alternative approach to consider would include the use of aprons and boots when engaging in poultry-related tasks. It was noted that a substantial portion of the

participants neither received the flu vaccination nor attended the training on avian influenza. When they got sick, they went directly to the pharmacy or did nothing. This highlights the need for targeted interventions and education to mitigate the risks associated with AI exposure in this population.

Knowledge

The results of our research illustrated that a substantial portion of poultry workers possess knowledge about AI. However, there is a considerable proportion of individuals who have direct contact with poultry workers but lack knowledge of AI. Addressing this gap should be the primary focus of awareness efforts. Our KAP survey demonstrated that the main source of information for many poultry workers was their friends/relatives before the COVID pandemic, although these sources may not be reliable during the COVID pandemic. On the other hand, the secondary source of information was veterinary services, which is a trustworthy source of information (10).

One of the lessons learned during the pandemic was the importance of the communication strategy plan for COVID-19, and the impact of this reached everyone regardless of their age or socioeconomic level (24). The same communication strategic plan could be extended to AI prevention. In future we need to consider there are many platforms, such as social media, posters, and website assets, where the participants access information, some of them more accessible than others. These avenues could be explored for public health messaging. For poultry workers a communication strategy could be consider ways to provide information through friends/relatives and official authorities (25,26).

Education played a vital role in the knowledge and practices of poultry workers regarding the prevention of AI. Different research findings in the KAP studies undertaken in other nations have demonstrated that knowledge can significantly impact the prevention of AI. Higher education levels have been shown to improve poultry workers knowledge of avian influenza (27–30). To prevent these diseases from affecting poultry, it is crucial to increase comprehension of AI and maintain the training. An example of this was what local authorities in Cambodia did for the case of Avian influenza A(H9N2) in Siem Reap mentioned in the introduction.

As individuals acquire further knowledge regarding AI and ways for preventing AI transmission, they get insights into the specificities of the circulating virus, including its transmission processes, symptoms of illness, and the scope of its impact on human health, whereas *Liang et al.* in China on LBMs that the successful dissemination of information about Highly Pathogenic Avian Influenza (HPAI) assumes a crucial role in promoting the implementation of preventative measures among poultry workers. LBM workers acquire knowledge about AI from a variety of information sources are more likely to recommend government preventative actions compared with those who have access to a limited number of sources (23).

Attitude and practice

Our findings show that the majority of participants have a keen interest in learning more about AI and exhibit concerns about its future consequences. However, it is important to note that a sizeable portion of individuals are still uncertain when it comes to their level of worry about the risk of AI. This confirms the previous section of knowledge regarding the need for targeted educational efforts.

In relation to the significance of personal hygiene among poultry workers, our study found that a considerable number of them possessed poor knowledge and adhered to proper hand-washing practices. This finding may be attributed to the timing of our research, which coincided with the COVID-19 pandemic, prompting heightened awareness among poultry workers regarding the importance of masks and handwashing. Nonetheless, it is evident that these same workers may have encountered challenges in comprehending and implementing measures related to Avian Influenza, as their primary focus remained on sanitizer usage and hand hygiene due to the COVID-19 pandemic. This measure is not only to prevent COVID-19 but also to reduce avian influenza circulation and other disease spread (32).

In our study, the poultry workers reported that live poultry originated from different areas in Cambodia and were available for sale and slaughter at the three LBMs. This situation carries potential risks as these poultry may carry AIVs, posing a threat of transmission to both healthy poultry and the poultry workers. A study recommended the proactive substitution of live poultry trade with a central slaughtering system would probably reduce the zoonotic risk to a minimum, although it should be noted that AIV-contamination of chicken carcasses may conceivably continue to pose a threat through freshly slaughtered, chilled poultry (33) is highly effective for

reducing viral amplification and persistence in LBMs and consequently minimizes zoonotic risk.

Limitations

We acknowledge the presence of biases in our study, particularly recall bias because the poultry workers were prompted to recall past events or experiences before the COVID-19 pandemic. Poultry workers may selectively recall certain events or experiences based on their personal beliefs be confused with the passing of time, resulting in an incorrect rendition of the past and current situation. As no baseline data were available this was the most practical approach to attempting to understand changes in KAP over time, however we understand that it is likely to be limited in its accuracy for representing the true situation.

We acknowledge the existence of biases in our study, especially recall bias, as we prompted the poultry workers to recall past events or experiences prior to the COVID-19 pandemic. Based on their personal beliefs and the passage of time, poultry workers may selectively recall certain events or experiences, leading to an incorrect representation of the past and current situation. Given the lack of baseline data, we took the most practical approach to comprehending changes in KAP over time, further acknowledging its potential limitations in accurately representing the true situation.

Furthermore, the relatively small sample size undoubtedly limited our ability to identify significant differences comparing the situations of poultry farmers before and during the pandemic. Despite this constraint, the results we obtained provide valuable insights, allowing us to understand or hypothesize about the impact that the COVID-19 pandemic may have had on the attitudes and practices of farm populations. This limitation underscores the need for further research with larger samples to confirm and refine our preliminary observations and hypotheses regarding behavioural dynamics in times of health crises.

Recommendations

In terms of controlling and preventing AI in LBMs in a sustainable manner:

Poultry workers:

- Enforce and improve personal hygiene measures, continue using the NPIs, and apply good practices in handling poultry.

Market management team:

- Provide hand hygiene stations with running water, soap or alcohol-based handrub, and proper sinks.
- Include strategically placed hand hygiene devices in a way that they are accessible for poultry workers.
- Encourage the poultry workers using masks, aprons and gloves.

Local authorities:

- Implement and enforce biosafety measures.
- Separate the area of live animals from the market aiming to reduce risks of contamination.
- Strengthen public awareness and educational strategies considering sociocultural and local aspects for consumers and vendors.
- Monitor and notify the government when an outbreak of AIVs occurs.
- Continue training, updating the information for good animal practice for poultry workers.
- Allocate funds and invest in ensuring that PPEs are provided to these poultry workers.

Government:

- To liaise and work with local authorities, regulators, and market managers to adopt strategies and implement interventions that will assess and mitigate risks for public health protection in LBMs.

- Develop a specific policy and legal framework for the management of LBMs.
- Include education strategies on LBMs aimed at schoolchildren and consumers so that they become actors of change.

3.4 Conclusion

In conclusion, we found no correlation between poultry workers' knowledge, attitudes, and preventative practices before and during COVID-19. Furthermore, our study showed that poultry workers are aware of AI; however, their attitudes and practices demonstrated a certain limitation in using protective equipment while working with poultry. The study has provided the most up-to-date information to help understand the knowledge, attitudes, and perceptions of poultry handlers at three Cambodian markets in relation to AI prevention. Taking action to mitigate the risk of AIVs is important to improve the safe handling of live and dead poultry. The study will inform targeted public health initiatives, enabling them to concentrate on enhancing control and risk reduction measures. By providing the study results to public health policy makers and national and international organisations, academia may target interventions and further research to improve knowledge and reduce infection and transmission risk.

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Appendix 3.1: A structured questionnaire

Institut Pasteur du Cambodge

Knowledge, attitudes, and practice influencing risk behaviors around avian influenza during the COVID pandemic among live poultry market workers, 2022-2023

ចំណេះដឹង ឥរិយាបថ និងការអនុវត្តដែលមានឥទ្ធិពលលើអាកប្បកិរិយាដែលមានហានិភ័យ

នៅជុំវិញជំងឺគ្រុនផ្តាសាយបក្សីក្នុងអំឡុងពេលកូវីដ ក្នុងចំណោមអ្នកធ្វើការនៅតាមទីផ្សារបសុបក្សីរស់ 2022-2023

ID Code: |___|___|___|___| (O = Orussey Market, T= Takeo market, C= Chbar Ampov, and eg. T001)

1. Interview Date: _____ 2. Interviewer's name: _____

Personal information **ព័ត៌មានផ្ទាល់ខ្លួន**

3. Where is your place of residence? តើកន្លែងស្នាក់នៅរបស់អ្នកនៅឯណា?

Village: |_____| District: |_____|

Commune: |_____| Province: |_____|

4. Name of the participant
ឈ្មោះអ្នកចូលរួម |_____|

5. Age (years) |_____| 6. Gender 1[_] Male 2[_] Female

7. Phone number |_____|

8. What is your highest education level completed? 1[_] No schooling 2[_] Non-formal education 3[_] Primary school
តើកម្រិតអប់រំខ្ពស់បំផុតរបស់អ្នកបានបញ្ចប់កម្រិតណា? 4[_] Secondary school 5[_] Degree level/high school
6[_] College/University and above

9. Business/work place 1[_] Orussey Market 2[_] Takeo Market
កន្លែងធ្វើការ/អាជីវកម្ម

10. Job status 1[_] Owner of the business 2[_] Worker
ឋានៈទីការងារ 4[_] Others _____

11. What is your type of work in the market? 1[_] Sell 2[_] Slaughter 3[_] Middleman 4[_] Transport 5[_] Other_____
តើការងាររបស់អ្នកនៅក្នុងទីផ្សារគឺជាអ្វី?

12. How many years have you been working in the poultry sector? តើអ្នកធ្វើការក្នុងវិស័យបសុបក្សីប៉ុន្មានឆ្នាំហើយ?
1[_] < 1 year 2[_] 2-5 years 3[_] 6-10 years 4[_] Above 10 years

Knowledge, attitudes, and practice influencing risk behaviors

ចំណេះដឹង ឥរិយាបថ និងការអនុវត្តដែលមានឥទ្ធិពលលើអាកប្បកិរិយាដែលមានហានិភ័យ

Questions	Before the COVID pandemic មុនកូវីដកត្តាត	Current situation ស្ថានភាពបច្ចុប្បន្ន
13. What is your monthly income? តើចំណូលប្រចាំខែរបស់អ្នកគឺជាអ្វី?	1[_] Under 350 $ 2[_] 350 to 600$ 3[_] 601 to 1000$ 4[_] Above 1000$	1[_] Under 350 $ 2[_] 350 to 600$ 3[_] 601 to 1000$ 4[_] Above 1000$
14. How many hours per day do you working in the poultry? តើអ្នកធ្វើការនៅបសុបក្សីប៉ុន្មានម៉ោងក្នុងមួយថ្ងៃ?	_____	_____
15. Where do the poultry come from? តើបក្សីមកពីណា?	_____	_____
16. Do you touch sick or dead poultry by hands? តើអ្នកប៉ះសត្វមាន់ឈឺ ឬងាប់ដោយដៃទេ?	0[_] No 1[_] Yes	0[_] No 1[_] Yes
17. After touching poultry, wash hands? (Multiple choices) បន្ទាប់ពីប៉ះបសុបក្សី លាងដៃ?(ជម្រើសច្រើន)	1[_] Use soap or hand sanitizer 2[_] Clean with water 3[_] Nothing	1[_] Use soap or hand sanitizer 2[_] Clean with water 3[_] Nothing

18. When you are working, do you wear: (Multiple choices) ពេលអ្នកកំពុងធ្វើការតើអ្នកពាក់: (ជម្រើសច្រើន)	1[_] Gloves 2[_] Boots 3[_] Apron 4[_] Face mask 0[_] No	1[_] Gloves 2[_] Boots 3[_] Apron 4[_] Face mask 0[_] No
19. Have your heard about Avian influenza? តើអ្នកធ្លាប់លឺអំពីជំងឺគ្រុនផ្តាសាយបក្សីទេ?	0[_] No 1[_] Yes 9[_] Don't know # If NO & Don't know, go to 21	0[_] No 1[_] Yes 9[_] Don't know # If NO & Don't know, go to 21
20. Source of Information ប្រភពព័ត៌មាន	0[_] No 1[_] Social media 2[_] Television 3[_] Leaflets/booklets 4[_] Friends/relatives 5[_] Vet officers 6[_] Other_____	0[_] No 1[_] Social media 2[_] Television 3[_] Leaflets/booklets 4[_] Friends/relatives 5[_] Vet officers 6[_] Other_____
Do you think you can be infected flu virus by direct contact: តើអ្នកគិតថាអ្នកអាចឆ្លងមេរោគផ្តាសាយដោយការប៉ះផ្ទាល់ខ្លួន		
21. with infected human? ជាមួយមនុស្សមានជងផ្តាសាយបក្ស	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
22. with infected poultry? ជាមួយបក្សីមានជំងឺផ្តាសាយបក្សី	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
23. with cages of infected poultry? ជាមួយទ្រុងបក្សីដែលមានជំងឺផ្តាសាយបក្សី?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
24. through water of infected poultry? តាមរយៈទឹកដែលមានជំងឺផ្តាសាយបក្សី?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
25. through air ? តាមរយៈខ្យល់?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
26. Avian influenza is serious disease? គ្រុនផ្តាសាយបក្សី ជាជំងឺធ្ងន់ធ្ងរ?	0[_] No 1[_] Yes 2[_] Not sure	0[_] No 1[_] Yes 2[_] Not sure
27. Avian influenza can prevented? តើជំងឺផ្តាសាយបក្សីអាចការពារបានទេ?	0[_] No 1[_] Yes 2[_] Not sure	0[_] No 1[_] Yes 2[_] Not sure
28. Do you worried of getting infected by avian influenza? តើអ្នកបារម្ភខ្លាចឆ្លងជំងឺគ្រុនផ្តាសាយបក្សីទេ?	1 2 3 4 5 (eg. 1=Not worried, 3= Note Sure, 5=Extremely worried)	1 2 3 4 5 (eg. 1=Not worried, 3= Note Sure, 5=Extremely worried)
29. Do you worry about your family/friends geeting bird flu? តើអ្នកបារម្ភពីគ្រួសារ ឬមិត្តភក្តិរបស់អ្នកកើតជំងឺផ្តាសាយបក្សីទេ?	0[_] No 1[_] Yes 2[_] Not sure	0[_] No 1[_] Yes 2[_] Not sure
30. Have you ever attended any training/communication evets on influenza virus? តើអ្នកធ្លាប់បានចូលរួមវគ្គបណ្តុះបណ្តាល/ការទំនាក់ទំនងស្តីពីមេរោគគ្រុនផ្តាសាយដែរឬទេ?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
31. If yes, what are they? បើបាទ/ចាស តើជាអ្វី?	_____	_____
32. Have you heard about antibiotic resistant? តើអ្នកធ្លាប់លឺអំពីភាពស៊ាំថ្នាំអង់ទីប៊ីយ៉ូទិចទេ?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
33. Do you want to know more about avian influenza? តើអ្នកចង់ដឹងបន្ថែមអំពីជំងឺគ្រុនផ្តាសាយបក្សីទេ?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
34. If yes, what do you want to know? បើមែន តើអ្នកចង់ដឹងពីអ្វី?	_____	_____

35. Do you concern about Avian influeza outbreak in the future? តើអ្នកបារម្ភពីការផ្ទុះនៃជំងឺផ្តាសាយបក្សីនៅពេលអនាគតដែរឬទេ?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
36. What will you do if you are sick with fever, sneeze, cough? តើអ្នកនឹងធ្វើដូចម្តេចប្រសិនបើអ្នកមានជំងឺគ្រុនក្តៅ កណ្តាស់ ក្អក?	0[_] No 1[_] Buy medicine by myself 2[_] Go to pharmacy 3[_] Private clinic 4[_] Public hospital 9[_] Nothing	0[_] No 1[_] Buy medicine by myself 2[_] Go to pharmacy 3[_] Private clinic 4[_] Public hospital 9[_] Nothing
37. Have you injected flu vaccine? តើអ្នកបានចាក់ភ្នាក់សាំងផ្តាសាយទេ?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
38. Are you interested in a flu vaccine? តើអ្នកចាប់អារម្មណ៍លើភ្នាក់សាំងផ្តាសាយទេ?	0[_] No 1[_] Yes 9[_] Don't know	0[_] No 1[_] Yes 9[_] Don't know
39. If yes, why? បើបាទ/ចាស ហេតុអ្វី?	_____	_____

40. Did you stop working during COVID pandemic? 0[_] No 1[_] Yes
តើអ្នកឈប់ធ្វើការរំខុងពេលកូវីដកន្លាតឬ?

41. If yes, why? What did you do? _____
បើបាទ/ចាស ហេតុអ្វី? តើអ្នកបានធ្វើអ្វី?

42. Do you use hand sanitizer and clean your hand very often currently? 0[_] No 1[_] Yes
តើអ្នកប្រើទឹកអាកុលលាងដៃ និងលាងដៃញឹកញាប់ណាស់ដែរទេ?

43. If yes, why? _____
បើបាទ/ចាស ហេតុអ្វី?

44. What do yo do after working with the poultry, please details before the COVID pandemic and current situation?
តើអ្នកធ្វើអ្វីបន្ទាប់ពីធ្វើការជាមួយបសុបក្សី សូមព័ត៌មានលម្អិតមុនពេលជំងឺកូវីដកន្លាត COVID និងស្ថានភាពបច្ចុប្បន្ន?

_____

_____

45. What are your recommendation for the prevention and control of avian influenza?
តើអ្នកមានអនុសាសន៍អ្វីខ្លះសម្រាប់ការបង្ការ និងគ្រប់គ្រងជំងឺផ្តាសាយបក្សី?

_____

_____

Appendix 3.2: Distribution of Knowledges, attitudes, and practice before and after the COVID pandemic.

Characteristic	Before the COVID pandemic (n=100)		During the COVID pandemic (n=100)		X^2	p-value
	N	%	N	%		
Knowledge					1.7	0.191
Poor Knowledge	34	34.0	43	43.0		
Good Knowledge	66	66.0	57	57.0		
Attitude					0.0	0.879
Poor Attitude	32	32.0	31	31.0		
Good Attitude	68	68.0	69	69.0		
Practice					0.9	0.346
Poor Practice	92	92.0	88	88.0		
Good Practice	7	7.0	12	12.0		

Appendix 3.3: The additional information provided by poultry worker study participants from three Markers link to AIVs.

Information	Details
Origin of the live birds within the selected markets	• The poultry workers bought poultry from different areas of the country, including villages and companies. • During the fieldwork, we noticed poultry and ducks were kept in enclosing or stalls together.
Reasons of poultry workers interested in Avian influenza	• To prevent themselves from becoming infected with the virus. When they learn more about AI and how to avoid AI transmission, they will be able to defend themselves against it. • To understand more about the origin of AIV, which includes the details of the circulating virus, the symptoms of infection, the way of transmission, and the severity of the virus's effect on human health.
Reasons of poultry workers interested in flu vaccination	• It could prevent and shield them from AVI and protect them from the AVI disease. • Prevention of illness because it helps to protect against the influenza virus.
Use hand sanitizer and clean your hands very often currently	• Most poultry workers used hand disinfectant to kill the viruses and bacteria. • Importantly, use for COVID prevention
Activities of after working with poultry	• Poultry workers always took a shower or bath following their workdays. • Prior to engaging in any other activities at home, they changed their clothes. • Some individuals wash their hands with water, alcohol, or hand sanitizer. In addition, just a small proportion (1.2%), reported that they did not change their clothes after work.

Recommendation for the prevention and control of avian influenza from participants	• Suggested to be vaccinated for AVI vaccine. • Knowledgeable about AVI treatment. • After working with poultry, they clean their hands with soap, wear a mask and gloves, clean the stores, and change their clothes. • More attention should be put on AVI self-prevention.

Chapter 4: Evaluation of one influenza surveillance system: Severe Acute Respiratory Illness (SARI) Laboratory-based surveillance system in children based on two paediatric hospitals, 2014-2022

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Preface

The purpose of this study is to assess the characteristics of the severe acute respiratory illness (SARI) monitoring system in Cambodia from 2014 to 2022. It addresses the requirement for the Master of Philosophy in Applied Epidemiology (MAE) to conduct surveillance evaluation analysis. This was only a small part of data which was taken from two paediatric hospitals where big databases from sy-lab, specifically designed for laboratory use were located.

Lessons learned

This study helped me develop surveillance evaluation skills using information and tools sourced from the Centers for Disease Control (CDC). The main skill I learnt from this project was how to effectively report on the quality of the data.

Public health impact

It is crucial to have access to high-quality data to evaluate the efficacy and efficiency of a public health surveillance system. This evaluation will enhance the SARI surveillance system by providing information on the current system's strengths and weaknesses. The collection and reporting of rapid and reliable data will assist the team's management. In addition, the results of this evaluation will assist and inform the design of future surveillance studies to ensure the system's ongoing operational maintenance.

Acknowledgements

I am extremely grateful to my supervisors, Dr. Erik Karlsson, Dr. Sowath Ly, Dr. Claude Flamand, and Dr. Samantha Colquhoun, for their insightful comments. I am extremely grateful to Julia Guillebaud for sharing her knowledge on surveillance evaluation and Florian Girond for helping with the map. Without clear instructions, it is difficult to determine the best method to perform a task.

Abstract

Background

A billion individuals have seasonal influenza each year, resulting in 3-5 million severe cases and 290,000 to 650,000 respiratory deaths, with 99% of under-5 influenza deaths in developing nations. Developing countries, such as Cambodia, experience an estimated 7547 hospitalisations due to influenza, with children under five accounting for nearly half of these cases. Cambodia has implemented a clinical and virological Severe Acute Respiratory Illness (SARI) monitoring system since 2005. Starting in 2014, the country included patients from two major pediatric hospitals, namely Kuntha Bopha and Jayavarman VII, targeting children under 18 years old, primarily in response to avian influenza virus outbreaks. This study aims to assess the SARI system in these two pediatric hospitals between 2014 and 2022, focusing on its quality and utility.

Methods

Since 2014, the SARI surveillance system has been in place to collect epidemiological and virological data on influenza surveillance. Two public pediatric hospitals, located in two different areas, provided this data. We conducted a study on seven surveillance system attributes from 2014 to 2022, including simplicity, flexibility, data quality, acceptability, sensitivity, representativeness, and timeliness.

Results

One notable advantage of the Kantha Bopha system was its flexibility, which allowed for effective monitoring of viral infections beyond influenza viruses, resulting in a fair knowledge rate of 70.23%. However, other attributes showed decreased knowledge, including simplicity (41.69%), data quality (52.4%), acceptability (46.70%), representativeness (25%), and timeliness (51%).

Conclusion

In the seven-attribute examination, the SARI could use significant improvement in several areas. The system demonstrated flexibility by including a monitoring system that could detect and identify multiple infections in addition to influenza viruses. To improve data comprehensiveness, quality, timeliness, and system acceptability, we need to increase system efficiency.

Abbreviations

ANU	The Australian National University
CDC	Centers for Disease Control and Prevention
CRF	Case Report Form
ILI	Influenza-like Illness
IPC	Institut Pasteur du Cambodge
MAE	Master of Applied Epidemiology
NECHR	National Ethics Committee for Health Research
NIC	National Influenza Centre
SARI	Severe Acute Respiratory illness
USCDC	United States Centers for Disease Control and Prevention
WHO	World Health Organization

4.0 Introduction

Globally, acute lower respiratory infection ranks as the second most prevalent contributor to morbidity and the third most prevalent contributor to mortality across all age cohorts (1). Seasonal influenza affects a billion people a year, producing 3-5 million severe cases and 290,000 to 650,000 respiratory fatalities, with 99% of under-5 influenza mortality in underdeveloped countries (2,3). Severe Acute Respiratory Illness (SARI) is one of the most common causes of childhood illness and concerns for public health. Children with chronic illnesses are some of the most vulnerable populations. SARI surveillance aims to identify hospitalised individuals suffering from severe respiratory illnesses linked to influenza. To do this, it uses a case definition suggested by the World Health Organization (WHO) or one that is specific to each country to find people who have severe cases of influenza-related respiratory illness (2–5). Since 2009, Cambodia has been monitoring the flu, monitoring both outpatients with influenza-like illness (ILI) and hospitalized SARI patients. We have registered all patients who meet the Cambodia SARI case definition at eight sentinel surveillance sites (5). However, we estimated a total of 7547 hospitalisations related to influenza in Cambodia, with children under the age of 5 accounting for over half of this number (8).

In 2006, a collaboration between the Virology Unit of the Institut Pasteur du Cambodge (IPC), the Communicable Disease Control Department of the Ministry of Health, and the WHO national office led to the establishment of a National Influenza Centre (NIC) in Cambodia. The NIC aimed to monitor and pinpoint circulating influenza virus strains associated with both mild and severe illnesses (9). Since 2014, the Virology Unit, IPC, has conducted SARI surveillance in two pediatric hospitals within the Kantha Bopha Foundation network, namely Kantha Bopha in Phnom Penh and Jayavarman VII in Siem Reap province, collecting epidemiological and virological data related to influenza monitoring. Since its implementation, the SARI surveillance system has experienced numerous modifications to variables and changes in case definition, but it has never undergone evaluation for the quality of its attributes or its utility.
Furthermore, the report evaluated the system's characteristics and usage and provided appropriate development recommendations. The results of this evaluation will help to enhance knowledge of the SARI surveillance system in Cambodia and other limited-resource regions.

Purpose of the evaluation

This specific SARI surveillance system aims to detect influenza viruses (both human seasonal and avian influenza spillover) within the selected pediatric hospitals. Understanding the beneficial effects of SARI procedures required an awareness of the system's sensitivity. The

2001 updated criteria for evaluating the public health monitoring system (10), published by the US Centers for Disease control and Prevention (USCDC).

The evaluation's particular objectives were to:

1. Describe the SARI surveillance system's usefulness.
2. To evaluate the SARI surveillance systems as simplicity, flexibility, data quality, acceptability, sensitivity, representativeness, timeliness.
3. To enhance the SARI surveillance system's implementation.

Scope of evaluation for the USCDC

The USCDC recommends evaluating a surveillance system based on nine characteristics: simplicity, flexibility, data quality, acceptability, sensitivity, positive predictive value, representativeness, timeliness, and stability (10). These nine qualities are described below in Table 4.1.

Table 4. 1. The definition of surveillance system attributes from the USCDC guide

Surveillance attribute	**Definition**
Simplicity	*The descriptions of the SARI case management flowchart, notification, and investigation were used to assess the characteristic of simplicity:* *A well-detailed case-management flowchart with well documented connections.*
Flexibility	*A flexible public health surveillance study can adapt to changing information needs or operating conditions with little additional time and standard data formats, so it might be considered flexible. Alternatively, the study has the capability to identify additional respiratory viruses.*
Data quality	*Data quality reflects the completeness and validity of the data recorded in the surveillance study.*
Acceptability	*The acceptability of the information study is assessed indirectly based on the qualities of timely notification and timely sample collection.*
Sensitivity	*First, at the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system. Second, sensitivity*

	can be defined as the ability to detect outbreaks, including the ability to monitor changes in the number of cases over time.
Predictive value positive	*Not applicable.* *Predictive value positive (PVP) is the proportion of reported cases that have the health-related event under surveillance*
Representativeness	*A public health surveillance system should be representative and accurate in describing the occurrence of health-related events over time, as well as their distribution in the population by place and person.*
Timeliness	*The following are used for:* 1. *Healthcare quickness: The number of days between the beginning of SARI symptoms and hospitalisation* 2. *Timeliness of sample collection: the number of days between hospitalisation and sample collection.* 3. *Notification of result: the number of days between the date of result*
Stability	*Not applicable (The doctors and nurse are there; however, we did not interview them).* *Refers to reliability (i.e., the ability to collect, manage, and provide data properly without failure) and availability (the ability to be operational when it is needed) of the public health surveillance study.)*

4.1 Methods

Attributes and characteristics of the SARI surveillance

The evaluation of the surveillance system was conducted according to the USCDC's guidelines, considering seven attributes: simplicity, flexibility, data quality, acceptability, sensitivity, representativeness, and timeliness (10). We applied quantitative analysis to examine these features, as detailed in Table 4.3.

In this surveillance evaluation, we did not interview or access the health professionals responsible for the system. This study used secondary data.

The assessment of data quality involved evaluating the extent to which various aspects of the data collection process followed established protocols. This included measuring the completeness of patient interview forms, ensuring proper transmission of forms, verifying the collection and testing of respiratory specimens, and reviewing patient sign and symptom records, as well as primary diagnoses, to ensure compliance with surveillance case definitions.

The measurement of the time required for the collection, transport, and processing of forms and specimens, as well as the time required for the availability of laboratory results, was part of the timeliness assessment.

We employed the previously employed assessment methodology and scoring framework to ensure the reliability of our results. We classified data points falling below 60% as exhibiting poor knowledge, and those falling between 60% and 79% as displaying fair knowledge. We deemed data points equal to or over 80% to indicate good knowledge (12–15) (See in the Table 4. 2 below):

Table 4. 2. Details the process of the evaluation followed by the calculation of the performance

Attributes and Indicator	Details about the calculation
Simplicity	
• The proportion of samples collected from admitted SARI patients	Number of samples/ total number of patients that met SARI requirements History of fever or measured fever of ≥38 ^{0} and cough; with onset within the last 10 days
• The proportion of minimal data were collected from admitted SARI patients	Number of missing value / Total number of variables
Flexibility	
• Proportion of samples screened for viruses other than influenza	Number of samples tested for viruses other than influenza / Number of samples tested for influenza
Data quality and completeness	
• Proportion of SARI form with complete data	Number of each variable without at least one missing or missing value / Total number of variables
Acceptability	
• Perform observation from other attributes	Average of the proportion existed
• Sample collection	Timely collection within the same day of hospitalisation
Sensitivity	
• Proportion of number outbreak identified by the system	Number of positive cases/Total number of inclusions
Representativeness	
• Proportion of sample with positive influenza results	Capturing all the data, are there gaps, how representative is the data collected of the number of cases
Timeliness	
• Proportion of onset and collection sample in hospital	Timely collection within 7 days the onset and collection
• Proportion of hospitalisation and sample collection	Timely collection within 7 days hospitalisation and collection

Data sources

In Cambodia, SARI includes two selected children's hospitals. This surveillance encompassed two public health care inpatient hospitals, identifying SARI patients. We gathered clinical and demographic information, as well as respiratory specimens, from these locations, ensuring that the patients were under 16 years old. The Virology Unit at IPC securely stored the collected information in an Epi database.

General description of the surveillance system between 2014 and 2022

Data collection

Inclusion for data analysis

All patients enrolled and tested in the SARI surveillance system between 2014 and 2022, aged below 16 years old, were used for the purpose of the study.

Exclusion criteria for data analysis

Patients missing key information, such as age, name of sentinel site, and results, were excluded from the study. The evaluation of total variables from the results was not feasible due to the enormous number of variables (n=120). This study used the secondary data. However, the data were many missing information (see in Appendix 4.2).

The evaluation used data sourced from the Virology Unit. The data provided was used to calculate the percentages that represent the measurements.

In this surveillance evaluation, we did not interview or access the health professionals responsible in the system. This evaluation focused only on the analysis information indicated below:

1. Laboratory Form (See in Appendix 4.1): We included only the key information as some information was unreported or missing.
    - Reporting person
    - Patient details
    - Animal contact history
    - Signs and symptoms
    - Sample collection
2. Case Report Form (See in Appendix 4.2): This information followed WHO recommendations.
    - General information
    - Patient Epidemiological/ Contact history
    - Admission clinical signs and symptoms
    - Patient history

Table 4. 3. Characteristics of SARI surveillance system in Cambodia

Surveillance characteristics	SARI
Case definition	Acute respiratory infection with: · Measured fever (≥ 38 °C) · Sore throat · Short of breath · Any sign of acute lower respiratory tract infection
Catchment population	In patient
Paediatric hospital	· Kuntha Bopha · Jayavarman VII
Specimen Collection	Nasopharyngeal and/or throat swabs, sometimes accompanied by serum, fecal, or cerebrospinal fluid
Surveillance objectives	1. describe the clinical characteristics of paediatric patients 2. analyze the virus subtypes identified in these patients' specimens

Evaluation process and Data analysis

We exported data from Epidata (version 3.0) software and imported laboratory data from Microsoft Excel into a CSV file. The data was imported into Stata 18.0, a statistical software developed by StataCorp LLC, located in College Station, TX (11). We used Stata 18.0 for all subsequent statistical analyses. On a monthly and annual basis, the analysis involved estimating the average proportion of hospitalisations in enrolled facilities.

Ethics statement

The evaluation protocol and methods were not submitted for review or approval by the National Ethics Committee for Health Research (NECHR). This evaluation was conducted solely for the purpose of internal quality improvement under the Australian National University's broad waiver from ethics requirements for surveillance evaluations (2017/909).

4.2 Results

Socio demographic characteristics and spatial distribution of the patients

During the evaluation period, a total of 896 patients were included in SARI from two Paediatric hospitals. However, only 776 were tested (275 patients originating from Kantha Bopha hospital and 501 patients from Jayavarman VII hospitals) (See in Figure 4. 1).

Below is indicated that patients included and excluded from the evaluation period from two paediatric hospitals namely Kuntha Bopha hospital and Jayavarman VII hospital.

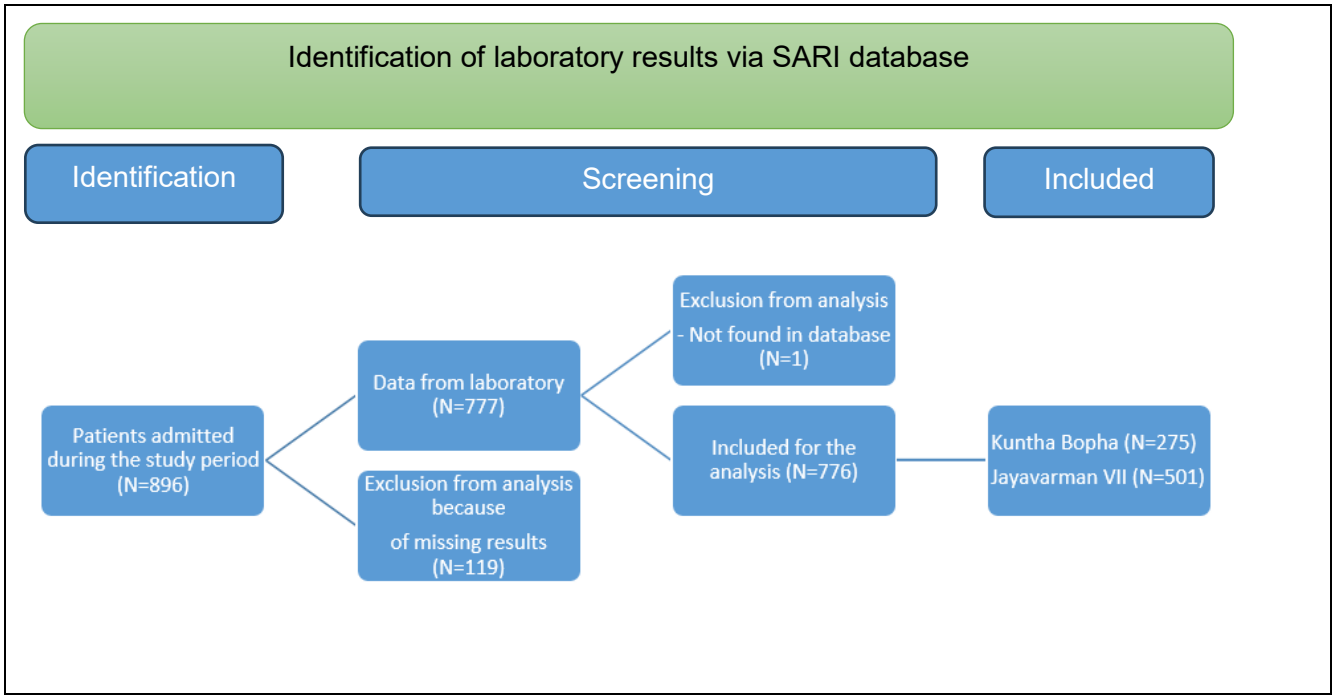


Figure 4. 1. Flow chart of the SARI surveillance of included and excluded, 2014-2022

The system included a total of 776 patients between 2014 and 2022. The majority of patients in the study sample originated from Jayavarman VII Hospital, accounting for 501 out of 776 patients, which represents 65% of the total. 2014 saw the highest number of patients, accounting for 112 out of 776 patients, or 14% of the total, while 2022 saw the lowest number, with just 30 out of 776 patients, or 4% of the total. On the other hand, the data indicates that Kuntha Bopha Hospital recorded the highest number of patients in 2016, with 54 out of 776 patients, representing 7% of the total. On the other hand, 2015 saw the lowest number of patients, with only 12 out of 776 patients, accounting for 2% of the total.

Figure 4. 2 shows the map of patients who admitted to paediatric hospital according to their province of residency in Cambodia from 2014 to 2022. SARI patients were referred from all provinces throughout the country except from Mondulkiri province. Patients admitted in Phnom Penh site were mainly residents from surrounding areas.

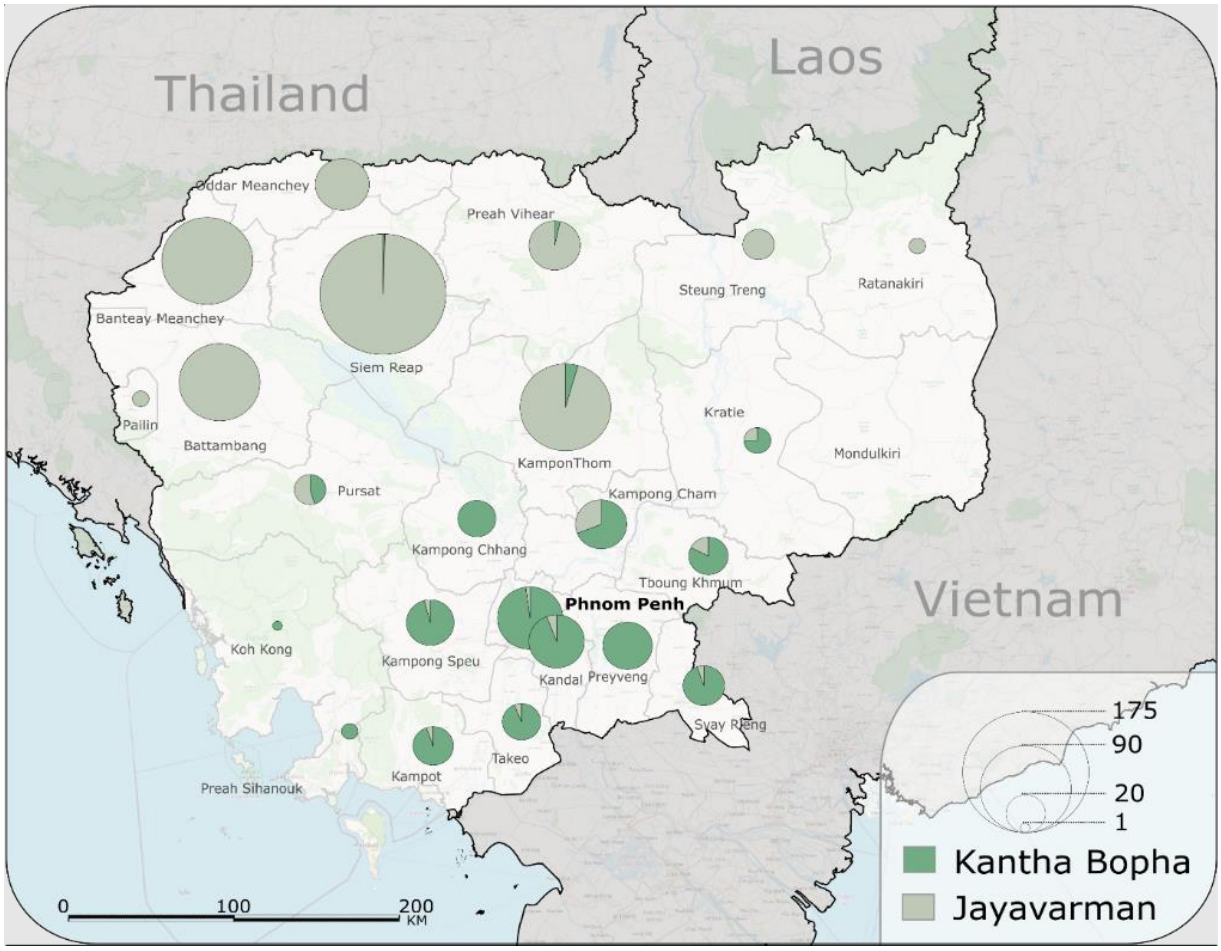


Figure 4. 2. Map showing numbers of SARI patients who sought to Kantha Bopha in Phnom Penh and Jayavarman VII paediatric in Siem Reap hospitals, by residence area from 2014 to 2022 (n=776)

Seasonality of influenza and circulating strains

The Figure 4. 3, on average, the percentage of samples that tested positive for influenza mostly occurred in the years from May to September. Nevertheless, absence of testing occurred between December 2020 and October 2022 because of COVID-19.

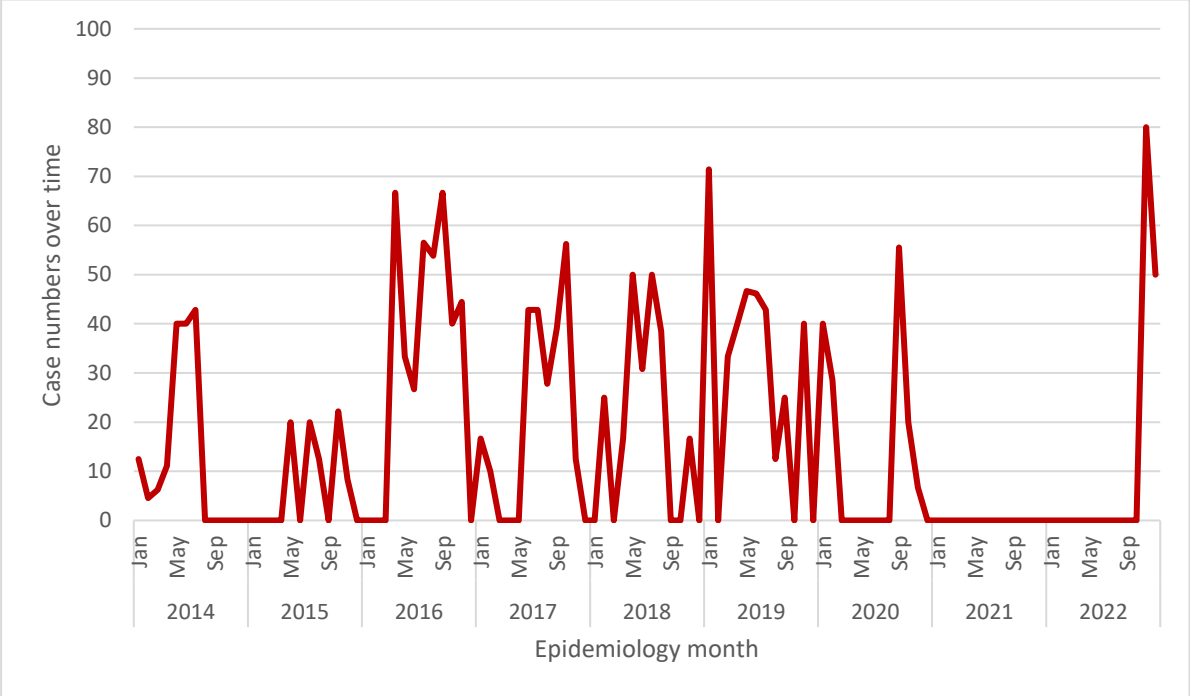


Figure 4. 3. IPC Laboratory-confirmed influenza-positive (2014-2022)

The demographic data obtained from the laboratory form indicated 383 (49.36%) aged from two to four years old and 398 (51.29%) of these cases being attributed to male patients in Table 4. 4. We found that the median age of the patients, representing the patients, was 4.06 years, with an interquartile range (IQR) of 0.1–15. Jayavarman VII enrolled 501 out of 776 patients, accounting for 64.56% of the total. A total of 275 out of 776 patients registered at Kantha Bopha, representing 35.44%.

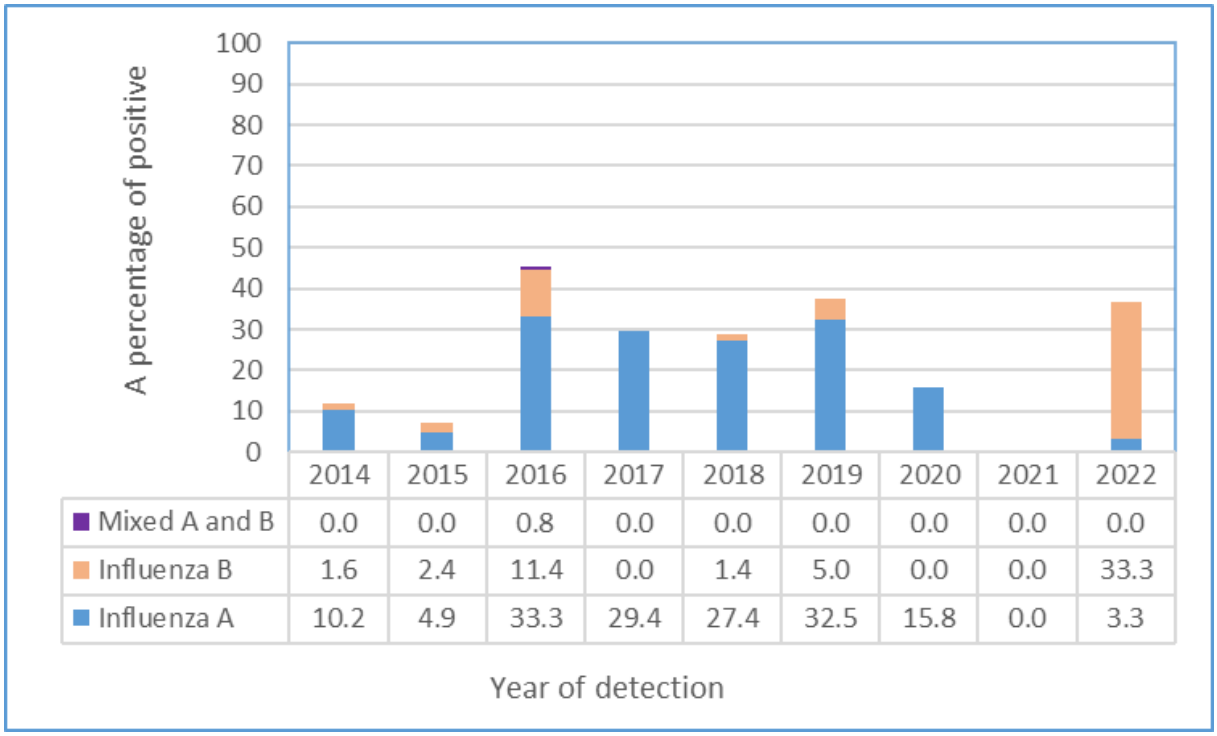
Table 4. 4. Socio-demographic characteristics and laboratory diagnosis of SARI patients in the KTBH system 2014-2022

Characteristic	Kuntha Bopha (n=275)	Jayavarman VII (n=501)	Total (n=776)
Age (years)			
0- 1 year	70 (25.45)	97 (19.36)	167 (21.51)
2-4 years	125 (45.45)	256 (51.50)	383 (49.36)
5 year and above	79 (28.73)	146 (29.14)	225 (28.99)
Missing	1 (0.36)	0	1 (0.13)
Age, median (IQR), y	3.71 (0.1-14.8)	4.26 (0.2-15)	4.06 (0.1-15)
Sex			
Male	140 (50.91)	258 (51.50)	398 (51.29)
Female	135 (49.09)	243 (48.50)	378 (48.71)
Influenza virus results (rRT-PCR)			
Influenza A detected	62 (22.55)	98 (19.56)	160 (20.62)
A (H1N1 pdm)	51 (18.55)	77 (15.37)	128 (16.49)
A(H3N2)	14 (5.09)	17 (3.39)	31 (3.99)
A(H5N1)	0	0	0
A(H7N9)	0	0	0
Influenza B detected	16 (5.82)	18 (3.59)	34 (4.38)
Mixed influenza A and B	0	1 (0.20)	1 (0.13)
Negative	197 (71.64)	386 (77.05)	583 (75.13)
Type of infection			
Bacterial infection	65 (23.64)	107 (21.36)	172 (22.16)
Viral infection*	188 (68.36)	323 (64.47)	511 (65.85)
Mix infection	10 (3.64)	27 (5.39)	37 (4.77)
No infection	12 (4.36)	44 (8.78)	56 (7.22)

*Included: rhino, corona, human metapneumovirus, pandemic H1N1/09 virus etc.

Influenza circulating stains

On average, influenza-positive samples exceeded 45.5% positive cases in the years 2016 followed by 37.5% positive cases with a combination of positive cases of influenza A and B, and in 2019 and 2022 was 36.6%. It is interesting to observe that the year 2021 saw a complete absence of positive influenza cases because the pandemic, we focused on the COVID-19 testing. On the contrary, the rate of positive cases in the remaining years (2014, 2015, 2017, 2018 and 2020) was comparatively smaller, with less than 30% cases recorded as seen in Figure 4. 4.



	2014	2015	2016	2017	2018	2019	2020	2021	2022
Mixed A and B	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Influenza B	1.6	2.4	11.4	0.0	1.4	5.0	0.0	0.0	33.3
Influenza A	10.2	4.9	33.3	29.4	27.4	32.5	15.8	0.0	3.3

Figure 4. 4. Laboratory confirmed number of yearly influenza virus types from both hospitals (2014-2022)

Attributes and characteristics of the SARI surveillance evaluation

The analysis of the seven surveillance system attributes was conducted prior to the conclusion of the 2022 influenza season in Table 4. 5.

Table 4. 5. Results of the SARI system in Cambodia from 2014 to 2022 from the data source at IPC

Attributes and Indicator	Indicator value	Classification performance
Simplicity		
• The proportion of samples collected from admitted SARI patients	30.93%	**Poor knowledge**
• The proportion of minimal data were collected from admitted SARI patients	52.45%	**Poor knowledge**
Flexibility		
• Proportion of samples screened for viruses other than influenza	70.23%	**Moderate knowledge**
Data quality and completeness		
• Proportion of SARI form with complete data	52.45%	**Poor knowledge**
Acceptability		
• Perform observation from other attributes	44.69%	**Poor knowledge**
• Sample collection	48.71%	**Poor knowledge**
Sensitivity		
• Proportion of number outbreak identified by the system	20.62%	**Poor knowledge**
Representativeness		
• Proportion of sample with positive influenza results	25%	**Poor knowledge**
Timeliness		
• Proportion of onset and collection sample in hospital	44.07%	**Poor knowledge**
• Proportion of hospitalisation and sample collection	57.73%	**Poor knowledge**

Simplicity

During the assessment phase, it was seen that there was a significant decline in knowledge as shown in Table 4. 5. The data presented in the table reveals that only 30.93% (n= 240) of the samples obtained from hospitalized SARI patients satisfied the necessary SARI criteria. A total of 407 hospitalized SARI patients, accounting for 52.45% of the gathered data.

Flexibility

During the evaluation period, it was seen that there was a fair knowledge. The SARI platform has been used for the surveillance of respiratory viruses, excluding influenza, since 2014, as shown in Table 4. 4 and Table 4. 5.

Data quality and completeness

The SARI system has been specifically developed to collect extensive epidemiological patient data, including a wide range of information under its monitoring framework. However, the data that we gathered were not entirely obtained just from physicians. Hence, after carefully examining the document, we have chosen to use the primary data for the purpose of evaluation in this attribution (Appendix 4.1 and Appendix 4.2), it was seen that the information that we included in this analysis were contained all data elements by the WHO (16).

With 62 key questions on patient interview forms had complete measures 52.45% (n=407) over the nine years analysed and completeness of SARI data were poor and measure all specimen collection and testing were high 100% (n=776) of SARI patients had respiratory specimen collected and tested for influenza (see Table 4. 4 and Figure 4. 5).

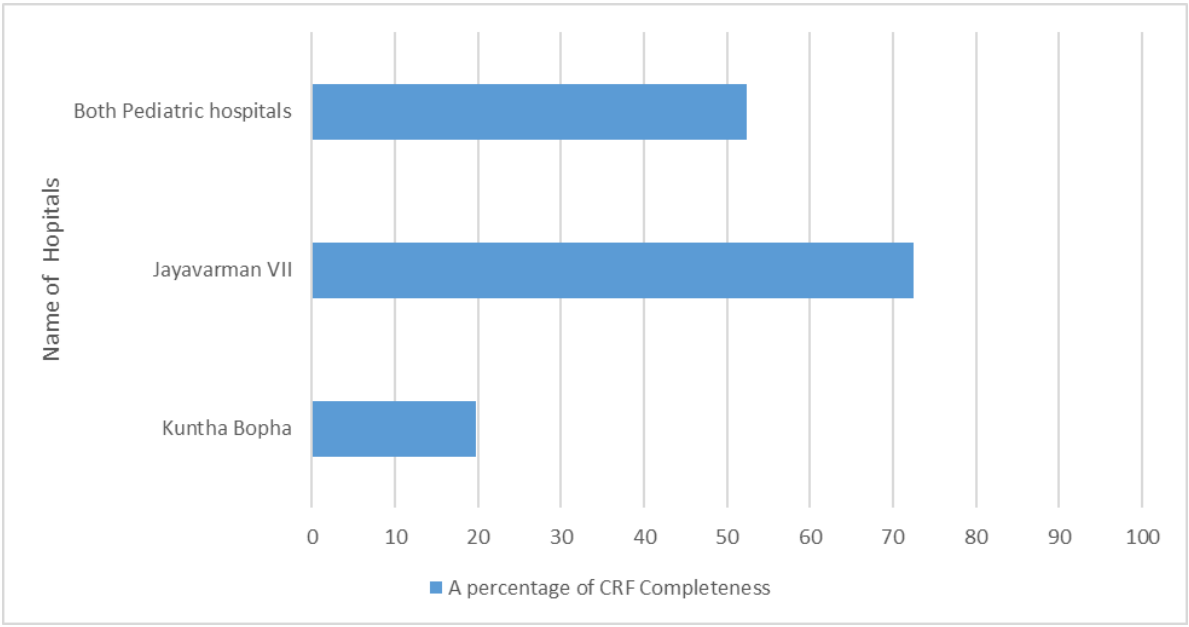


Figure 4. 5. Completeness of data collected on SARI CRF from both paediatric hospitals spanning the years 2014 to 2022

Acceptability

According to Table 4. 5, on the evaluation period, indirect measures of acceptability include the evaluation of various observations based on the attributes under evaluation. In this context, it is notable the fact that the SARI program had inadequate outcomes, accounting for 46.70% overall as shown.

Sensitivity

In Table 4. 5, overall sensitivity is evident in its weak performance, as shown a proportion of outbreak identify only 20.62%.

Representativeness

As indicated in Table 4. 5, this assessment showed weak results, as it only managed to capture 25% of the gathered data related to the number of positive influenza findings. The limited number of paediatric hospitals provided presented a relative limitation in terms of the national representativeness of the SARI surveillance. Nevertheless, it provided us with an in-depth knowledge of the situation of these majors' two hospitals.

Timeliness

The SARI programme demonstrated poor timeliness, only 44.07% (n=342) of patients had respiratory specimens taken within seven days of the beginning of symptoms, and 57.73% (n=448) of patients had respiratory specimens obtained within seven days of being admitted to the hospital in Table 4.5.

4.3 Discussion

Overall, the KTBH SARI system showed a moderate level of flexibility, as it can detect numerous etiologies during the surveillance process. This flexibility facilitates the surveillance of many viruses and some bacteria that have significance for paediatric cases. The system's adaptability was shown in laboratory-based monitoring, which effectively monitored the prevalence of various respiratory infections.

However, evaluation of the SARI surveillance system indicated several areas for improved knowledge for six attributes. This need for improvement is particularly significant from a public health perspective.

Timeliness and sensitivity are considered the most essential qualities for a system aiming to promptly identify cases and epidemics. The measurement of timeliness lacks a common standard, as it includes the many delays that occur at each stage of the surveillance process, from symptom detection at the hospital, to specimen collection, to testing, and to reporting. In this evaluation, the assessment of timeliness involved the estimation of the mean reporting timeliness and the duration required for sample collection. Unfortunately, the system showed poor knowledge. Many factors may have influenced the performance of the site, including lack of adequate staff and simplify the forms. The limitations in personnel resources and the complexity of CRFs contribute to problems at the site. This highlights the importance of simplifying CRFs in order to improve the efficiency of the site, increase patient care, and address staffing concerns. Nevertheless, the presence of specialised monitoring personnel might potentially lead to a rise in enrolment rates. This corresponds to what is said on improving of the timeliness of surveillance systems.

As we found in the evaluation of the SARI surveillance system need to improve on representativeness. The current number of hospitals in Cambodia is insufficient, with only two hospitals available to serve the entire population. Increasing the number of hospitals would enhance coverage and improve the representativeness of the healthcare system. Furthermore, establishing additional surveillance hospitals/sites in other provinces of the nation could provide a more accurate representation of the influenza viruses currently prevalent. Nevertheless, the efficacy of increasing the quantity of monitoring sites in Cambodia for enhancing the comprehension of influenza from a virological and epidemiological perspective remains uncertain. However, Ieng et al. was conducted an evaluation study on influenza in three sentinel sites located in Svay Rieng, Siem Reap, and Kampong Cham provinces (8). The evaluation involved surveillance data on influenza-associated SARI cases over a one-year period to calculate the numerator, and hospital admission surveys were conducted to estimate the population denominator for each site. The findings revealed that the national annual rates of influenza-associated hospitalisations per 100,000 population were highest among the two youngest age groups, with rates of 323 for children under 1 year and 196 for children aged 1-4 years. A total of 7547 hospitalisations connected with influenza were projected for Cambodia, with children under the age of 5 accounting for over half of these

cases. The prospective increase in surveillance locations in Cambodia needs careful consideration due to many factors, including the associated budget, logistical challenges such as the need for frequent monitoring, and the possible implications for laboratory testing capacity and data quality. Rather than increasing the locations, it may be more effective to focus on enhancing the efficiency of sample collection and enrolment of patients who meet the SARI case definition at the current hospitals. The evaluation observed the poor perform of quality and comprehensiveness of the gathered epidemiological and virological data such as specific risk factors for severe illness associated with influenza and in-hospital outcomes. Specifically, the gathering of supplementary data on underlying medical issues has the potential to facilitate the ongoing surveillance of those at greater risk for severe disease associated with influenza. Additionally, this adjustment would bring the SARI system into minimal data collecting recommendations proposed by the WHO (5) would be beneficial for the system. Additionally, the poor knowledge of the simplicity of acceptability of the system. We should use of standardised operating procedures at hospitals or might be a relevant factor to consider depends on situation at both hospitals.

Limitations

We were unable to calculate stability and positive predictive values. We chose critical factors for this evaluation, which may explain the substantial degree of data inconsistency and missing information observed in this surveillance. We used only information from two pediatric hospitals.

Recommendation

We recommend:

- To simplify the SARI forms: as the current forms require a lot of information, much was left unknown or incomplete. It is recommended to include only significant, critical information in the SARI forms.

- To enhance staff motivation and training: a meeting should be conducted a quarterly basis to facilitate discussions regarding implementation challenges and necessary support, as well as to offer refresher training, and provide supplementary resources.

To ensure effective monitoring of the findings, the forms must be accessible inside the laboratory, as well as reporting information to the hospital.

4.4 Conclusion

The influenza surveillance system's evaluation revealed a weak understanding of the six attribute criteria. However, the system demonstrated notable flexibility, as it successfully demonstrated the capability to detect and identify several other types of infections in addition to influenza viruses. Improved effectiveness will enhance the system's performance.

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Appendix 4.1: Suspected Avian Influenza Hospital Investigation Form

Suspected Avian INFLUENZA
Hospital Investigation Form

Reporting person
Report date: ___/___/_____ reported by: _____ Tel: _____
Health facility _____ Commune: _____ District: _____ Province_____
Hospital of OPD patient number

Patient details
Name of patient Family:_____ Given _____
Date of birth/ Age ___/___/___ OR Age: ___Years _____ Months

Gender: MaleF☐male ☐

Permanent Address: Household's Chief nick name _____
Krom _____ Phum _____ Commune: _____
District _____ Province/city _____

Animal contact history: Poultry ☐ Birds ☐ Domestic animal ☐ Bats ☐ Rodents ☐ Monkeys/Primates ☐
Other animals _____
If yes, please explain type of contact hunt ☐ butcher ☐ clean ☐ eat ☐ raise/farm ☐ transport/handle ☐
Animal contact at work ☐ or in daily activities ☐

Admission history

	Date of Admission	
1st visited health Facility	_____/_____/_____	Health facility name:_____
2nd visited health Facility	_____/_____/_____	Health facility name:_____
3rd visited health Facility	_____/_____/_____	Health facility name:_____

Signs and symptoms

Date of onset of symptoms(fever): ____/_____/_____
Clinical symptoms at the time of admission to the present hospital

Fever >= 38°C	Yes ☐	No ☐	Not known ☐
Cough	Yes ☐	No ☐	Not known ☐
Sore throat	Yes ☐	No ☐	Not known ☐
Short of breath	Yes ☐	No ☐	Not known ☐
Chest X-ray performed	Yes ☐	No ☐	Not known ☐
Any sign of acuter lower respiratory tract infection	Yes ☐	No ☐	Not known ☐
WBC count performed	Yes ☐	No ☐	Not known ☐
Antiviral therapy	Yes ☐	No ☐	Not known ☐

If yes result: Total WBC count: _____ Lymphocytes: _____%

Other symptoms _____
Other symptom in family member or member of household? Yes ☐ No ☐
If yes, who _____ and what symptoms: _____

Samples collected

Nasopharyngeal swab	Date of collection	_____/_____/_____
Throat swab	Date of collection	_____/_____/_____
Serum	Date of collection	_____/_____/_____
Rectal swab	Date of collection	_____/_____/_____
Broncho-alveolar wash	Date of collection	_____/_____/_____

Laboratory information

Date of sample arrived at IPC: _____/_____/_____ at.....h.....mn

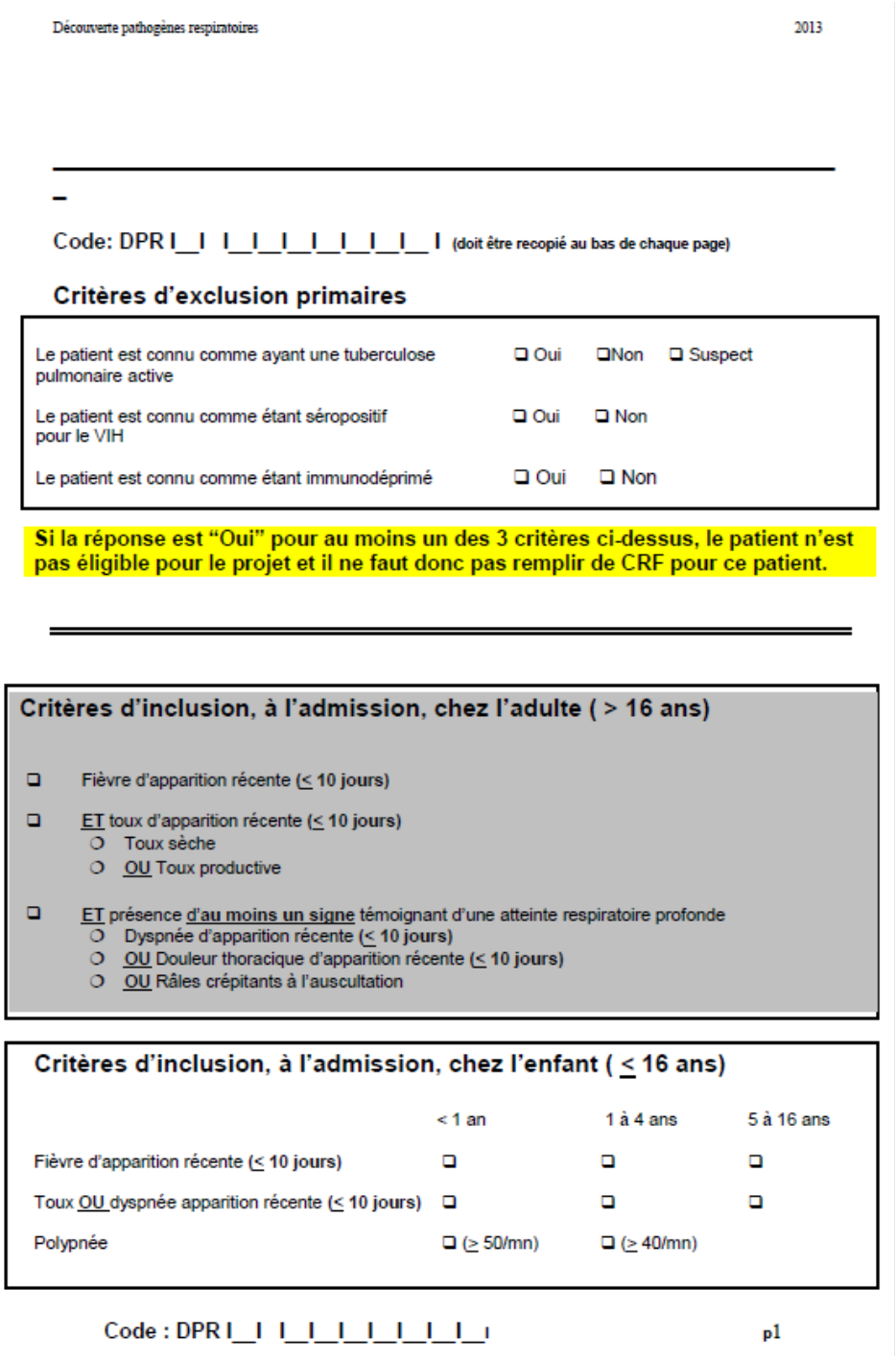
Appendix 4.2: Key essential minimum data collection for SARI surveillance Case Report Form for completing information (n=776)

Essential minimum data for SARI Surveillance	Characteristics	Total		Kuntha Bopha		Jayavarman VII	
		Number	%	Number	%	Number	%
General information:	ID	100	12.89	275	100	501	100
	Village	606	78.09	157	57.09	449	89.62
	Commune	663	85.44	204	74.18	459	91.62
	District	705	90.85	229	83.27	476	95.01
	Province	711	91.62	233	84.73	478	95.41
	Hospital name	776	100	275	100	501	100
	Sex	776	100	275	100	501	100
	Age	775	99.87	274	99.64	501	100
	Date of hospitalisation	600	77.32	134	48.73	466	93.01
	Date of Specimen collection	488	62.89	39	14.18	449	89.62
Patient Epidemiological/Contact history	Has the patient travelled within the past 10 days?	278	35.82	18	6.55	260	51.90
	Living with family?	484	62.37	21	7.64	463	92.42
	Patient contact with anyone with flu-like symptoms	392	50.52	24	8.73	368	73.45
	Patient contact with sick or dead CHICKENS during 14 days before symptom onset?	410	52.84	25	9.09	385	76.85
	Patient contact with sick or dead DUCKS during 14 days before symptom onset?	347	44.72	19	6.91	328	65.47
Admission clinical signs and symptoms:	History of fever	415	53.48	19	6.91	396	79.04
	Temperature	449	57.86	38	13.82	411	82.04
	Cough	502	64.69	114	41.45	388	77.45
	Sore throat	472	60.82	87	31.64	385	76.85
	Earache	395	50.90	22	8.00	373	74.45
	Wheezing	271	34.92	13	4.73	258	51.50
	Chest pain	403	51.93	23	8.36	380	75.85
	Muscle aches (myalgia)	389	50.13	24	8.73	365	72.85
	Joint pain (arthralgia)	397	51.16	22	8.00	375	74.85

	Fatigue/malaise	382	49.23	22	8.00	360	71.86
	Shortness of breath	487	62.76	105	38.18	382	76.25
	Lower chest wall indrawing	387	49.87	25	9.09	362	72.26
	Headache	396	51.03	23	8.36	373	74.45
	Altered consciousness/confusion	382	49.23	23	8.36	359	71.66
	Seizures	394	50.77	22	8.00	372	74.25
	Abdominal Pain	377	48.58	23	8.36	354	70.66
	Vomiting/nausea	394	50.77	22	8.00	372	74.25
	Diarrhoea	381	49.10	24	8.73	357	71.26
	Conjunctivitis	392	50.52	21	7.64	371	74.05
	Skin rash	383	49.36	22	8.00	361	72.06
	Skin Ulcers	394	50.77	22	8.00	372	74.25
	Lymphadenopathy	383	49.36	22	8.00	361	72.06
	Bleeding	390	50.26	22	8.00	368	73.45
	Frisson	454	58.51	21	7.64	433	86.43
	Convulsion	452	58.25	21	7.64	431	86.03
	Retro-orbital pain	466	60.05	21	7.64	425	84.83
	Date of onset of the illness	464	59.79	21	7.64	443	88.42
Patient History:	Congestive Heart Failure	364	46.91	19	6.91	345	68.86
	Hemiplegia or paraplegia	346	44.59	18	6.55	328	65.47
	Demetia	355	45.75	18	6.55	337	67.27
	Renal disease	261	33.63	16	5.82	245	48.90
	Chronic Pulmonary Disease	359	46.26	18	6.55	341	68.06
	Any malignancy (including leukaemia and lymphoma)	344	44.33	18	6.55	326	65.07
	Physician diagnosed asthma	355	45.75	18	6.55	337	67.27
	Metastatic solid tumor	340	43.81	18	6.55	322	64.27
	Rheumatologic disease	360	46.39	18	6.55	342	68.26
	AIDS/HIV	346	44.59	19	6.91	327	65.27
	Mild liver disease	356	45.88	18	6.55	338	67.47
	Obesity (as defined by clinical staff)	330	42.53	18	6.55	312	62.28
	Moderate or severe liver disease	357	46.01	18	6.55	339	67.66
	History of recurrent fever prior to admission	326	42.01	17	6.18	309	61.68

	Diabetes with chronic complications	346	44.59	18	6.55	328	65.47
	Proven Malaria	312	40.21	17	6.18	295	58.88
	Receiving immunosuppressant prior to admission	313	40.34	18	6.55	295	58.88
	Vaccination against influenza prio to the illness	230	29.64	13	4.73	217	43.31
	Any other risk factor(s) considered relevant:	4	0.52	1	0.36	3	0.60
	Died in hospital or palliative discharge?	53	6.83	1	0.36	52	10.38

Appendix 4.3: Case Report Forms and laboratory form for SARI patient



Découverte pathogènes respiratoires 2013

Code: DPR I__I I__I__I__I__I__I__I__I__I (doit être recopié au bas de chaque page)

Critères d'exclusion primaires

Le patient est connu comme ayant une tuberculose pulmonaire active	❑ Oui	❑Non	❑ Suspect
Le patient est connu comme étant séropositif pour le VIH	❑ Oui	❑ Non	
Le patient est connu comme étant immunodéprimé	❑ Oui	❑ Non	

Si la réponse est "Oui" pour au moins un des 3 critères ci-dessus, le patient n'est pas éligible pour le projet et il ne faut donc pas remplir de CRF pour ce patient.

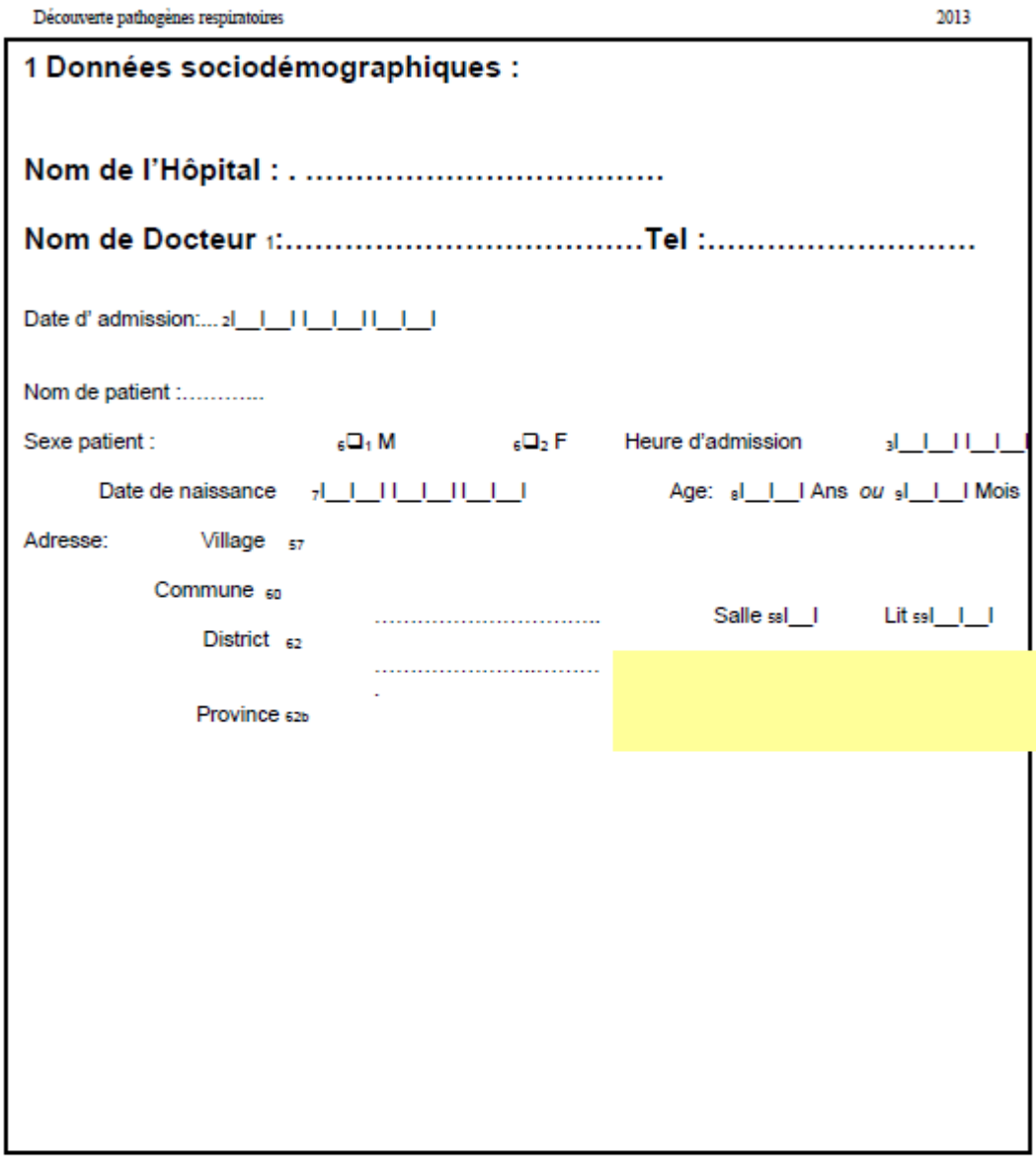
Critères d'inclusion, à l'admission, chez l'adulte (> 16 ans)

- ❑ Fièvre d'apparition récente (≤ 10 jours)
- ❑ ET toux d'apparition récente (≤ 10 jours)
  - ❍ Toux sèche
  - ❍ OU Toux productive
- ❑ ET présence d'au moins un signe témoignant d'une atteinte respiratoire profonde
  - ❍ Dyspnée d'apparition récente (≤ 10 jours)
  - ❍ OU Douleur thoracique d'apparition récente (≤ 10 jours)
  - ❍ OU Râles crépitants à l'auscultation

Critères d'inclusion, à l'admission, chez l'enfant (≤ 16 ans)

	< 1 an	1 à 4 ans	5 à 16 ans
Fièvre d'apparition récente (≤ 10 jours)	❑	❑	❑
Toux OU dyspnée apparition récente (≤ 10 jours)	❑	❑	❑
Polypnée	❑ (≥ 50/mn)	❑ (≥ 40/mn)	

Code : DPR I__I I__I__I__I__I__I__I__I p1



Découverte pathogènes respiratoires 2013

1 Données sociodémographiques :

Nom de l'Hôpital : . .....

Nom de Docteur 1:.....Tel :.....

Date d' admission:... 2|__|__| |__|__|__|__|

Nom de patient :.....

Sexe patient : 6❑1 M 6❑2 F Heure d'admission 3|__|__| |__|__|

Date de naissance 7|__|__| |__|__|__|__| Age: 8|__|__| Ans *ou* 9|__|__| Mois

Adresse: Village 57

Commune 60

District 62 ..... Salle 58|__| Lit 59|__|__|

Province 62b .....

Code : DPR |__| |__|__|__|__|__|__|__| p2

2 Interrogatoire: histoire de la maladie

Hospitalisation récente au cours des 3 dernières semaines $_{10}$❑$_0$ Non $_{10}$❑$_1$ Oui $_{10}$❑$_9$ Ne sait pas

Hospitalisation récente au cours des 12 derniers mois $_{10a}$❑$_0$ Non $_{10a}$❑$_1$ Oui $_{10a}$❑$_9$ Ne sait pas

Prise d'un traitement immunosuppresseur (corticoïdes …) $_{11}$❑$_0$ Non $_{11}$❑$_1$ Oui $_{11}$❑$_9$ Ne sait pas

Cancer évolutif $_{12}$❑$_0$ Non $_{12}$❑$_1$ Oui $_{12}$❑$_9$ Ne sait pas

Prise de médicaments au cours des 3 semaines précédant l'admission ?

$_{13}$❑$_0$ Non ❑$_9$ Ne sait pas ❑$_1$ Oui

Si « oui », pouvez-vous préciser si le patient a pris des antibiotiques ?

$_{14}$❑$_0$ Non, le patient n'a pas pris d'antibiotiques

$_{14}$❑$_9$ Je ne sais pas, je ne peux pas dire si le patient a pris ou non des antibiotiques

$_{14}$❑$_1$ Oui, le patient a pris des antibiotiques, mais je ne peux pas dire lesquels

$_{14}$❑$_2$ Oui, le patient a pris les antibiotiques suivants

Précisez: $_{15}$ ……

Vaccination Haemophilus B $_{16}$❑$_0$ Non ❑$_1$ Oui, nombre de doses: I__I ❑$_9$ Ne sait pas

3 Facteurs de risque d'infection respiratoire $_{17}$❑$_0$ Non ❑$_1$ Oui

$_{17a}$ ❑ Exposition à des volailles mortes ou malades
$_{17a1}$ Date de début de mortalité des volailles I__I__I I__I__I I__I__I
$_{17a2}$ A mangé des volailles mortes/malades (dans les 15 jours) I__I__I I__I__I I__I__I
$_{17a3}$ A touché/ joué avec des volailles mortes/ malades (dans les 15 jours) I__I__I I__I__I I__I__I
$_{17b}$ ❑ Tabagisme dans la famille
$_{17c}$ ❑ Allergie
$_{17c}$ ❑ Asthme

Code : DPR I__I I__I__I__I__I__I__I__I p3

4 Symptômes

	Ancienneté des symptômes			
	0 – 4 j	5 – 9 j	10 – 14 j	> 14 j
20a❑ Fièvre a l'admission	❑1	❑2	❑3	❑4
20b❑ Fièvre 3 jours précédant l'admission	❑1	❑2	❑3	❑4
20f❑ Toux sèche 20g❑ Toux productive	❑1	❑2	❑3	❑4
20i❑ Dyspnée	❑1	❑2	❑3	❑4
20j❑ Douleur thoracique	❑1	❑2	❑3	❑4

20c❑ Céphalées 20d❑ Sueurs 20e❑ Frissons 20n❑ Hémoptysie

20m❑ Douleurs musculaires 20n❑ Douleurs articulaires

20k❑ Nausées 20L❑ Diarrhées Autres 20z .....

5 Examen clinique à l'admission

Date de l'examen

21a |__|__|/|__|__|/|__|__|

Température: 21|__|__|.|__|°C Pouls: 22|__|__|__| /mn Poids: 23|__|__| kg
Taille 23a|__|__|__| /cm

Tension artérielle: 24|__|__|__|/|__|__|__|25 mm Hg Fréquence respiratoire: 26|__|__|__| /mn

Oxymétrie en air ambiant SaO_2 : 27|__|__|__| % 27a❑ Confusion

Existence de signes d'atteinte respiratoire a l'examen clinique 28❑0 **Non** 28❑1 **Oui**

29a❑ Cyanose 29l ❑ Battement des ailes du nez

29j ❑ Tirage intercostal 29k ❑ Tirage sus sternal ou autre signe de détresse respiratoire aigue …)

29b❑ Crépitants
29l ❑ Crépitants en foyers d'un seul coté
29m ❑ Crépitants bilatéraux ou diffus

29c❑ Sibilants 29d❑ Rhonchi

29e❑ Matité à la percussion 29f❑ Diminution du murmure vésiculaire

29g❑ Transmission anormale des vibrations vocales 29h❑ Frottement pleural

Existence de co-morbidités 32❑0 **Non** 32❑1 **Oui**

32a❑ Hépatique 32b❑ Cardiovasculaire 32c❑ Rénale

32d❑ Neurologique 32e❑ Onco-hématologique 32f❑ Diabète

6 Antibiotiques au cours de l'hospitalisation		Date de début	Date de fin
33d❑	**Pénicilline G** [Oracilline, Ospen ...]	33d2|__|__||__|__||__|__|	33d3|__|__||__|__||__|__|
33e❑	**Pénicilline A** [Ampicilline, Amoxicilline ...]	33e2|__|__||__|__||__|__|	33e3|__|__||__|__||__|__|
33f❑	**Amoxicilline/Acide Clavulanique** [Augmentin ...]	33f2|__|__||__|__||__|__|	33f3|__|__||__|__||__|__|
33g❑	**Pénicilline M** [Oxacilline, Cloxacilline ...]	33g2|__|__||__|__||__|__|	33g3|__|__||__|__||__|__|
33h❑	**Céphalosporine 1ere Génération** [Céfalexine, Céfalotine…]	33h2|__|__||__|__||__|__|	33h3|__|__||__|__||__|__|
33i❑	**Céphalosporine 2eme Génération** [Céfoxitine…]	33i2|__|__||__|__||__|__|	33i3|__|__||__|__||__|__|
33j❑	**Céphalosporine 3eme Gen** [Céfixime, Céfotaxime, Céftriaxone, Céftazidime…]	33j2|__|__||__|__||__|__|	33j3|__|__||__|__||__|__|
33k❑	**Aminoside** [Gentamicine]	33k2|__|__||__|__||__|__|	33k3|__|__||__|__||__|__|
33l❑	**Cycline** [Tétracycline, Doxycycline, Minocycline]	33l2|__|__||__|__||__|__|	33l3|__|__||__|__||__|__|
33m❑	**Macrolide C14** [Erythromycine, Roxythromycine …]	33m2|__|__||__|__||__|__|	33m3|__|__||__|__||__|__|
33n❑	**Macrolide C15** [Azythromycine]	33n2|__|__||__|__||__|__|	33n3|__|__||__|__||__|__|
33o❑	**Fluoroquinolone** [Norfloxacine, Péfloxacine, Ciprofloxacine, Ofloxacine…]	33o2|__|__||__|__||__|__|	33o3|__|__||__|__||__|__|
33p❑	**Quinolone antipneumococcique** [Lévofloxacine]	33p2|__|__||__|__||__|__|	33p3|__|__||__|__||__|__|
33q❑	**Imidazolé** [Métronidazole]	33q2|__|__||__|__||__|__|	33q3|__|__||__|__||__|__|
33r❑	**Sulfamide** [Cotrrimoxazole]	33r2|__|__||__|__||__|__|	33r3|__|__||__|__||__|__|
33s❑	**Autre antibiotique**	33s2| | || | || | |	33s3| | || | || | |

7 Autres traitements au cours de l' hospitalisation

33u❑ Corticothérapie 33v❑ Cardiodiurétiques 33w❑ Bronchodilatateurs

Découverte pathogènes respiratoires 2013

8 Prélèvements sanguins

NFS 36❑0 Non faite 36❑1 Faite Date: 36a|__|__||__|__||__|__|

Hémoglobine 37|__|__|.|__| g / dL Lymphocytes 38 |__|__|.|__| 10³ / mm³

Leucocytes 39|__|__|.|__| 10³ / mm³ Neutrophiles 41 |__|__|.|__| 10³ / mm³

Monocytes 41c |__|__|.|__| 10³ / mm³ Eosinocytes 41d |__|__|.|__| 10³ / mm³

Monocyte-Eosinophiles-Basophiles (MXD) 41b |__|__|.|__| 10³ / mm³

Biochimie 42❑0 Non faite 42❑1 Faite Date: 42a|__|__||__|__||__|__|

SGOT 43|__|__|__| U / L SGPT 44|__|__|__| U / L

Créatinine 45|__|__|. __|__| mg / dL Glycémie 46b|__|__|__| mg / dL

Sérologie VIH 47❑0 Non faite 47❑1 Faite Date: 47a|__|__||__|__||__|__|

47b❑0 Négative 47b❑1 Positive 47b❑9 Indéterminée

9 Radio du thorax

48❑0 Non faite 48❑1 Faite Date: 48a|__|__| |__|__| |__|__|

48b❑0 Normale 48b❑1 Anormale

49❑ Il existe des anomalies radiologiques évoquant une infection respiratoire aiguë basse

49a ❑ Syndrome alvéolaire ❑3 Unilatéral gauche ❑4 Unilatéral droit ❑2 Bilatéral

49b ❑ Syndrome interstitiel ❑3 Unilatéral gauche ❑4 Unilatéral droit ❑2 Bilatéral

49c ❑ Excavation ❑1 Unique ❑2 Multiple

49d ❑ Epanchement pleural ❑3 Unilatéral gauche ❑4 Unilatéral droit ❑2 Bilatéral

49e ❑ Il existe des signes évoquant des lésions préexistantes, y compris des sequelles de tuberculose (par exemple : DDB, Calcification, Retraction, Pachypleurite…)

49f ❑ Il existe des signes évoquant une tuberculose évolutive

49g ❑ Il existe des signes d'insuffisance cardiaque décompensée (exemple :cardiomégalie, opacité en aile de papillon, pleurésie bilatérale…)

49h ❑ **Pour l'enfant :** Il existe des signes évoquant une bronchiolite

10 Ponction pleurale

51a❑0 non faite ou echec ❑1 faite

A remplir seulement si pleurésie

51b Test Rivalta ❑9 Non fait ❑ fait ❑0 négatif ❑1 positif

Code : DPR |__| |__|__|__|__|__|__|__| p6

11 Recherche de BAAR à l'examen direct (Ziehl / Auramine)

Crachat 1	s2❑9 Non fait	❑Fait	Date : I__I__II__I__I s52a	s2❑0 Négatif	s2❑1 Positif
Crachat 2	s3❑9 Non fait	❑Fait	Date : I__I__II__I__I s53a	s3❑0 Négatif	s3❑1 Positif
Crachat 3	s4❑9 Non fait	❑Fait	Date : I__I__II__I__I s54a	s4❑0 Négatif	s4❑1 Positif
Crachat	s5❑9 Non fait	❑Fait	Date : I__I__II__I__I s55a	s5❑0 Négatif	s5❑1 Positif

12 Evolution au 3eme jour de traitement (si le malade n est pas sorti ou décédé avant)

L'état du patient s est amélioré ?	s5a	❑1 Oui	❑0 Non
La fièvre a disparu ?	s5b	❑1 Oui	❑0 Non

13 Statut du malade à la sortie

s6❑1 Le patient est sorti guéri de l'hôpital Date de sortie de l'hôpital : s7I__I__II__I__II__I__I

s6❑2 Le patient est sorti non guéri mais avec amélioration

s6❑8 Le patient est sorti non guéri et sans amélioration

s6❑3 Le patient est sorti de l'hôpital pour fin de vie a domicile

s6❑4 Le patient est décédé à l'hôpital

s6❑5 Le patient est sorti contre avis médical ou a fugué ou s'est évadé

s6❑6 Le patient a été transféré dans un autre hôpital

s6❑7 Le patient a été transféré dans un autre service (remplir la fiche bleue de transfert)

Code : DPR I__I I__I__I__I__I__I__I p7

14 Diagnostic final à la sortie de l'hôpital, *(plusieurs réponses possibles)*

[58a1] ❑ Pneumonie aigue ou bronchopneumonie

[58a4] ❑ Pleurésie

[59] ❑ Abcès pulmonaire

❑ Tuberculose pulmonaire
si oui [58a7] ❑ Avec BK positifs
[58a8] ❑ Avec BK négatif
[60] ❑3 Forme miliaire

[58a6] ❑ **Surinfection** sur séquelles d'ancienne maladie (par ex. sur ancienne tuberculose, sur
dilation des bronches, sur fibrose..)

[58b1] ❑ Oedème aigu du poumon

[61] ❑ Péricardite

[62] ❑ Possible Cancer

[58a3] ❑ Bronchite

[58a2] ❑ Bronchiolite aigue ou bronchite asthmatiforme chez l'enfant

[58a5] ❑ Surinfection de Bronchite Chronique (chez l adulte)

[58c] ❑ Problème ORL

[63] ❑ Asthme

[64] ❑ Infection d'un autre organe ou infection générale (exemple :dengue, typhoïde, malaria, abcès du foie, mal de Pott…)

[65] ❑ Découverte VIH
[66] ❑ Grippe
[67] ❑ Mélioïdose confirmée
[68z] ❑Autre
……..
……
……

Code : DPR I__I I__I__I__I__I__I__I p8

15 Résumé des investigations pratiquées

- ❑ **Radiographie thoracique**
  Si non fait précisez la raison :
  .....
- ❑ **Biochimie SISEA (transaminases + créatinine)**
  Si non fait précisez la raison :
  .....
- ❑ **Hémogramme**
  Si non fait précisez la raison :
  .....
- ❑ **Sérologie VIH**
- ❑ **Recherche de BK dans les crachats**
  Si non fait précisez la raison :
  .....
- ❑ **Hémoculture**
  Si non fait précisez la raison :
  .....
- ❑ **Collecte de crachat pour la culture standard**
  Si non fait précisez la raison :
  .....
- ❑ **Collecte de crachat pour la culture de BK**
  Si non fait précisez la raison :
  .....
- ❑ **Prélèvement nasopharyngé**
  Si non fait précisez la raison :
  .....
- ❑ **Prélèvement de gorge**
  Si non fait précisez la raison :
  .....
- ❑ **Prélèvement liquide pleural, si pleurésie**
  Si non fait précisez la raison :

Nom du patient : ..... Prénom : .....

Nom d'un parent (si enfant) :.....Téléphone :.....

Code : DPR I__I I__I__I__I__I__I__I__I p9

Appendix 4. 4: Case Record Form Suspect A(H5N1) cases.

Case Record Form – Suspect A(H5N1) cases

Participant Study ID code	

Form completed on Date:_____ Time: _____
Participant's mother: _____ Father:_____
Contact Number 1: _____ Contact Number 2: _____

1. Demographics This page completed: ☐ At admission ☐ During hospital stay ☐ After discharge

Patient identification code:_____Date of birth *(DD/MM/YYYY)* __/__/___OR Estimated age___ Years
Clinical centre: _____ Country:_____ Form completed by: _____
First name initial:_____ Surname initial:_____ Sex ☐ male ☐ Femal **Ethnicity:**____ ____☐Unknown
Weight (at admission): ____Kg/lbs.(circle) Height:____cm/inch(circle) MUAC(if age<5yrs) :____cm/inch(circle)
Admission date at this facility *(DD/MM/YYYY)*___/___/20__ Transfer from another facility:☐Yes ☐No ☐Unknown
If yes: Date admitted to other facility *(DD/MM/YYYY)*___/____/20___ Name of transfer facility: _____
Suspected/confirmed infection: H7N9:_____Novel coronavirus: _____ H5N1:_____ Other: _____
History of close contact with a case of infection above? ☐ Yes, suspected case ☐No ☐ Unknown
Has the patient travelled within 10days of symptom onset? ☐Yes ☐No ☐ Unknown If YES, state location blow:
Country: _____City: _____ Return Date (DD/MM/YYY) __/__/20__
Country: _____City: _____ Return Date (DD/MM/YYY) __/__/20__

Family (difficult to get info retrospectively, may not found in medical records)
Living with family ☐ Yes ☐ No, live alone
Number of family member: _____
Number of children aged <15 years: _____
Number of people living under the same roof: _____ (possible to have more than one family)
Number of household members developing flu-like illness (fever + cough/runny nose), during the 14 days before disease onset: _____
Contact with people with flu-like illness (fever + cough/runny nose) ☐ Yes ☐ No ☐ Unknown

Who (relationship)	When	Where	Symptoms

Contact with sick/dead poultry
Contact with sick/dead CHICKENS during 14 days before onset ☐ Yes ☐ No ☐ Unknown
Type of contact: ☐ Catch/carry ☐ Prepare ☐ Consume ☐ Transport
Origin of the chickens: ☐ Cambodia ☐ Vietnam ☐ Thailand ☐ Thailand ☐ Unknown
Contact with sick/dead DUCKS during 14 days before onset ☐ Yes ☐ No ☐ Unknown
Type of contact: ☐ Catch/carry ☐ Prepare ☐ Consume ☐ Transport
Origin of the chickens: ☐ Cambodia ☐ Vietnam ☐ Thailand ☐ Thailand ☐ Unknown

2.Co-morbidities & Risk Factors *(existing PRIOR TO ADMISSION & that are active problems)(Charison index will be calculated at analysis)*

Congestive heart failure	☐Yes ☐ No ☐Unknown	Diabetes with Chronic complications	☐Yes ☐ No ☐Unknown
Dementia	☐Yes ☐ No ☐Unknown	Hemiplegia or paraplegia	☐Yes ☐ No ☐Unknown
Chronic Pulmonary disease *(not asthma)*	☐Yes ☐ No ☐Unknown	Renal disease	☐Yes ☐ No ☐Unknown
Physician diagnosed asthma	☐Yes ☐ No ☐Unknown	Any malignancy including leukaemia &lymphoma	☐Yes ☐ No ☐Unknown
Rheumatologic disease	☐Yes ☐ No ☐Unknown	Metastatic solid tumor	☐Yes ☐ No ☐Unknown
Mild liver disease	☐Yes ☐ No ☐Unknown	AIDS/ HIV	☐Yes ☐ No ☐Unknown
Moderate or severe liver disease	☐Yes ☐ No ☐Unknown	Obese as defined by clinical staff	☐Yes ☐ No ☐Unknown

History of recurrent fever prior to admission? ☐Yes ☐ No ☐Unknown Proven Malaria? ☐Yes ☐ No ☐Unknown

Receiving immunosuppressant (including inhaled/oral corticosteroids) prior to admission? ☐ Yes ☐ No ☐ Unknown If YES:

Name of immunosuppressant	Dose and frequency	Route of administration	Duration
	☐ Unknown	☐ IV ☐ Oral ☐ Inhaled ☐ Others ☐ Unknown	☐ Days ☐ Weeks ☐ Unknown

Pregnant? ☐ Yes ☐ No ☐ Unknown ☐ NA Gestation at admission: _____ weeks(round to nearest)
Post-partum? ☐ Yes ☐ No ☐ NA Delivery date(DD/MM/YYYY)___/____/_____ outcome: ☐ live birth ☐ Still birth
Baby tested for infection above? ☐ Yes ☐ No ☐ Unknown If YES: ☐ Positive ☐ Negative Method: ☐ PCR ☐ Other:_____
Infants(<1year old): birth weight if known: _____ kg/lbs (circle) ☐ Term-born (≥37wk GA) ☐ Preterm (,37wk GA) ☐ Unknown
Breastfed? ☐ Yes ☐ No ☐ Unknown If YES: ☐ Still breastfeeding ☐ Discontinued (at _____ weeks)
Development appropriate for age? ☐ Yes ☐ No ☐ Unknown **Vaccinations appropriate for age & Country?** ☐ Yes ☐ No ☐ Unknown
Any other risk factor(s) considered relevant: _____

3.Signs and Symptoms at Admission *(Please complete Every Line)*
Date of onset of earliest symptom (DD/MM/YYYY):__/_____/20_____ OR if unknown, day-of –illness at admission:_____days
Temperature:_____ °C/°F(circle) HR: _____ beat per minute RR:_____breaths per minute
Systolic BP:_____ mmHg Diastolic BP: _____ mmHg Sternal Capillary refill time >2secs? ☐ Yes ☐ No ☐ Unknown
Intubated & Ventilated? ☐ Yes ☐ No ☐ Unknown If intubated & ventilated: FiO_2 _____ ☐ Unknown
Not Ventilated but receiving O_2? ☐ Yes ☐ No ☐ Unknown O_2 Saturation:____% On room air? ☐ Yes ☐ No ☐ Unknown
Severe dehydration? ☐ Yes ☐ No ☐ Unknown
Urine output: ☐ Oliguria (<1ml/kg/hr infants, <0.5ml/kg/hr children and adults) ☐ Anuria (no urine output) ☐ Unknown

Heart auscultation
Regular ☐Yes ☐No ☐NA Murmur ☐Yes ☐No ☐NA
Muffled ☐Yes ☐No ☐NA Describe: _____
Cyanosis ☐Yes ☐No ☐NA Jaundice ☐Yes ☐No ☐NA
Conscience, Glasgow score: _____
Lungs auscultation
Ronch ☐Yes ☐No ☐NA Crepitus ☐Yes ☐No ☐NA
Wheezing ☐Yes ☐No ☐NA Muffled ☐Yes ☐No ☐NA
Neurological signs
Neck rigidity ☐Yes ☐No ☐NA Mydriasis ☐Yes ☐No ☐NA
Focal neurological deficit (FND) ☐Yes ☐No ☐NA
Describe FND: _____

Admission signs and symptoms (associated with this episode of acute illness)

History of fever (>38°C)	☐Yes ☐No ☐Unknown	Lower chest wall in drawing	☐Yes ☐No ☐Unknown
Cough	☐Yes ☐No ☐Unknown	Headache	☐Yes ☐No ☐Unknown
With sputum production	☐Yes ☐No ☐Unknown	Altered consciousness / confusion	☐Yes ☐No ☐Unknown
Bloody sputum/hemoptysis	☐Yes ☐No ☐Unknown	Seizures	☐Yes ☐No ☐Unknown
Sore throat	☐Yes ☐No ☐Unknown	Abdominal pain	☐Yes ☐No ☐Unknown
Runny nose (rhinorrhea)	☐Yes ☐No ☐Unknown	Vomiting / nausea	☐Yes ☐No ☐Unknown
Ear ache	☐Yes ☐No ☐Unknown	Diarrhea	☐Yes ☐No ☐Unknown
Wheezing	☐Yes ☐No ☐Unknown	Conjunctivitis	☐Yes ☐No ☐Unknown
Chest pain	☐Yes ☐No ☐Unknown	Skin rash	☐Yes ☐No ☐Unknown
Muscle aches (myalgia)	☐Yes ☐No ☐Unknown	Skin ulcers	☐Yes ☐No ☐Unknown
Joint pain (arthralgia)	☐Yes ☐No ☐Unknown	Lymphadenopathy	☐Yes ☐No ☐Unknown
Fatigue /malaise	☐Yes ☐No ☐Unknown	Bleeding	☐Yes ☐No ☐Unknown
Shortness of breath	☐Yes ☐No ☐Unknown		

If bleeding, specify site: _____

Fever (history) ☐ Measured using thermometer ☐ Not measured
Frisson ☐ Yes ☐ No ☐ Unknown
Convulsion ☐ Yes ☐ No ☐ Unknown
Retro-orbital pain ☐ Yes ☐ No ☐ Unknown

Date of onset of the illness: _____
What was the 1st symptom the subject noticed: _____
Characteristic of the onset of illness ☐ Brutal ☐ Progressive ☐ Don't know
Aggravation ☐ Yes ☐ No
Date that the illness became more severe: _____
What were the main symptoms that led to hospitalization: _____

4. Admission Laboratory Results *(Please circle the unit used for each parameter, where appropriate. Enter "NM" if not measured*

Date laboratory samples collected *(DD/MM/YYYY)*:__/____/20____ ☐ No results available

Haemoglobin _____ g/L,g/dL Haematocrit _____ % WBC count _____x10⁹/L, 10³/µl

Platelets _____x10⁹/L, 10³/µl APTT/APRT *(circle)* PT/INR _____seconds

Biochemistry & Haematology

ALT/SGPT _____ U/L Bilirubin ____ µmol/L, mg/dL C-reactive protein _____ mg/L, nmol/L

AST/SGOT _____ U/L Glucose ____ mmol/L, mg/dL Erythrocyte Sed Rate_____ mm/h

Blood Urea Nitrogen _____mmol/L, mg/dL LDH _____ U/L Creatine kinase (CPK) _____ U/L

Creatinine _____ µmol/L, mg/dL Lactate ____ mmol/L, mg/dL

Blood Gas

Date blood gas performed (DD/MM/YYY)):__/___/20____ ☐ Blood gas not performed

Sample taken on: ☐ Room air ☐ Supplemental O_2 ☐ Unknown If receiving O_2, specify: ___ % or ___ l/min

Sample type: ☐ Arterial ☐ Venous ☐ Unknown

PO_2 _____ kPa, mmHg pH_____ HCO_3 _____mEq/L

PCO_2 _____ kPa, mmHg Base excess_____mmol/L Lactate _____mmol/L, mg/dL

Any other significant laboratory results: _____

Red blood cell count: _____ 1012/l

WBC count:

% Neutrophils: _____ % % Lymphocytes: _____ %

% Monocytes: _____ % % Eosinophils: _____ %

Sodium: _____ mmol/l Potassium: _____ mmol/l

Urea : _____ mmol/l Bilirubine Direct : _____ mmol/l

Albumine: _____ mmol/l

5. Complications: At any time during hospitalization did the patient experience *(please complete every line)*:

Viral pneumonitis	☐ Yes	☐ No	☐ Unknown	Cardiac arrest	☐ Yes	☐ No	☐ Unknown
Bacterial pneumonia	☐ Yes	☐ No	☐ Unknown	Bacteremia	☐ Yes	☐ No	☐ Unknown
Acute lung injury / ARDS	☐ Yes	☐ No	☐ Unknown	Coagulopathy or DIC	☐ Yes	☐ No	☐ Unknown
Pneumothorax	☐ Yes	☐ No	☐ Unknown	Anemia	☐ Yes	☐ No	☐ Unknown
Pleural effusion	☐ Yes	☐ No	☐ Unknown	Rhabdomyolysis or myositis	☐ Yes	☐ No	☐ Unknown
Bronchiolitis	☐ Yes	☐ No	☐ Unknown	Acute renal injury/failure	☐ Yes	☐ No	☐ Unknown
Meningitis/Encephalitis	☐ Yes	☐ No	☐ Unknown	Gastrointestinal bleeding	☐ Yes	☐ No	☐ Unknown
Seizure(s)	☐ Yes	☐ No	☐ Unknown	Pancreatitis	☐ Yes	☐ No	☐ Unknown
Stroke	☐ Yes	☐ No	☐ Unknown	Hepatic dysfunction	☐ Yes	☐ No	☐ Unknown
Congestive heart failure	☐ Yes	☐ No	☐ Unknown	Hyperglycemia	☐ Yes	☐ No	☐ Unknown
Cardiac infection (endo/myo/peri-carditis)	☐ Yes	☐ No	☐ Unknown	Hypoglycemia	☐ Yes	☐ No	☐ Unknown
Cardiac arrhythmia	☐ Yes	☐ No	☐ Unknown	Other	☐ Yes	☐ No	☐ Unknown

If bleeding, specify site: _____

6.Treatment: At any time during hospitalization, did the patient receive *(Please complete every line)*

if Daily Treatment was recorded on a DAILY RECORD FORM (Section 2), leave this section blank and check here ☐

Care on ICU/ITU/IMC/HDU? ☐ Yes ☐ No ☐ Unknown

If YES, state the Date of admission to ICU/ITU/IMC/HDU (DD/MM/YYYY):__/__/20____ ☐ Date Unknown

If Yes, state the Total number of days in ICU/ITU/IMC/HDU during this hospital stay:_____days ☐ Date Unknown

Supplemental oxygen? ☐ Yes ☐ No ☐ Unknown _____ If YES, duration: _____days

Non-invasive mechanical ventilation? (eg. BIPAP, CPAP) ☐ Yes ☐ No ☐ Unknown _____ If YES, duration: _____days

Invasive mechanical ventilation? ☐ Yes ☐ No ☐ Unknown _____ If YES, duration: _____days

Oscillatory Ventilation ☐ Yes ☐ No ☐ Unknown _____ If YES, duration: _____days

Extracorporeal membrane oxygenation (ECMO) or intervention lung-assist therapy (iLA)?

☐ ECMO ☐ iLA ☐ None ☐ Unknown ☐ Not available _____ If YES, duration: _____days

Renal replacement therapy (RRT) or dialysis? ☐ Yes ☐ No ☐ Unknown _____ If YES, duration: _____days

RRT required beyond discharge from hospital? ☐ Yes ☐ No ☐ Unknown

Plasmapheresis? ☐ Yes ☐ No ☐ Unknown Inotropes/vasopressors? ☐ Yes ☐ No ☐ Unknown

Oral rehydration only? ☐ Yes ☐ No ☐ Unknown Intravenous Immunoglobulin? ☐ Yes ☐ No ☐ Unknown

Blood transfusion or products? ☐ Yes ☐ No ☐ Unknown

OTHER intervention (please specify): _____

_____

7. Pathogen Testing *Only record results that are not recorded on DAILY RECORD FORM (section 4).*
Was pathogen testing performed? ☐Yes ☐No ☐Unknown If YES, complete each line below.

Date *(DD/MM/YYYY)*	Sample Type	Pathogen	Result	Method
___/___/20___	Nasal/NP swab	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Throat swab	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Nasal + Throat swab	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Sputum	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	BAL	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	ETA	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Stool/Rectal swab	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Urine	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Blood	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Other (specify): ________	Specify: ________	☐Positive ☐Not Done ☐Negative	☐PCR ☐Other: ________
___/___/20___	Serology	Specify: ________	☐Positive ☐Not Done ☐Negative	

Date of specimen shipment to Institut Pasteur: ____________

Date of specimen reception at Institut Pasteur: ____________

8. Other Infection: Did the patient test positive for any other infection? ☐Yes ☐No ☐Unknown If YES

☐Bacterial	Name of pathogen: ____________	Date of detection: (DD/MM/YYYY): ___/___/20___
☐Viral	Name of pathogen: ____________	Date of detection: (DD/MM/YYYY): ___/___/20___
☐Fungal	Name of pathogen: ____________	Date of detection: (DD/MM/YYYY): ___/___/20___
☐Other	Name of pathogen: ____________	Date of detection: (DD/MM/YYYY): ___/___/20___

9. Medication: While hospitalized or at discharge, were any of the following administered?

Antivirals? ☐Yes ☐No ☐Unknown Antibiotics? ☐Yes ☐No ☐Unknown

Corticosteroids? ☐Yes ☐No ☐Unknown Antifungals? ☐Yes ☐No ☐Unknown

Angiotensin converting enzyme inhibitors (ACE-Is) or angiotensin receptor blockers (ARBs)? ☐Yes ☐No ☐Unknown

Statins ☐Yes ☐No ☐Unknown If YES, was the patient taking statins prior to admission? ☐Yes ☐No ☐Unknown

Medication: list ONLY ANTI-INFECTIVE and CORTICOSTEROIDS administered in hospital or at discharge.

Name of medication (generic name preferred)	Start date (DD/MM/YYYY)	End date (DD/MM/YYYY)	Route of administration	Dose and frequency
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown

Medication before admission

Medication: list ONLY ANTI-INFECTIVE and CORTICOSTEROIDS administered in hospital or at discharge.				
Name of medication (generic name preferred)	Start date (DD/MM/YYYY)	End date (DD/MM/YYYY)	Route of administration	Dose and frequency
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown
	___/___/20___	☐On-going ___/___/20___	☐IV ☐oral ☐inhaled ☐other ☐unknown	☐unknown

Vaccination

Vaccination against influenza prior to the illness ☐Yes ☐No ☐Unknown

How long was latest injection before the illness? ________________________________

10. Outcome: Date outcome section completed (DD/MM/YYYY) ___/___/20___

Resolution of acute illness? ☐Yes ☐No ☐Unknown **If YES**, Date of resolution(DD/MM/YYYY): ___/___/20___ ☐ Unknown

Still in hospital? ☐ Yes ☐No ☐Unknown **Transferred to another facility?** ☐Yes ☐No ☐ Unknown

If transferred, date of transfer(DD/MM/YYYY):___/___/20___ Name of new facility: ____________________ ☐ Unknown

Discharged? ☐ Yes ☐No ☐Unknown If YES, state the date of discharge (DD/MM/YYYY)___/___/20___

Ability to self-care at discharge versus prior to illness: ☐Same as prior to illness ☐Decreased ☐Increased ☐Unknown

Post-discharge treatment *(if alive, check all that apply)*: Respiratory support/treatment? ☐Yes ☐No ☐Unknown

Renal Treatment? ☐Yes ☐No ☐Unknown Other Treatment? ☐Yes ☐No ☐Unknown If YES, specify:

Specify other treatment (Multiple permitted): ________________________________

Diagnoses at discharge:
1. ________________________________
2. ________________________________
3. ________________________________
4. ________________________________
5. ________________________________

Died in hospital or palliative discharge? ☐Yes ☐No ☐Unknown

If YES, date of death (DD/MM/YYYY): ___/___/20___ Cause(s) of death: ____________________

Was on autopsy performed? ☐Yes ☐No ☐Unknown

Key autopsy result: ________________________________

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Analysis of Chest X-ray

Mme/M: _____ Date: _____

BEFORE ANALYSIS	Is this x-ray:	
Well centered?	Yes ☐	No ☐
Well penetrated?	Yes ☐	No ☐
Patient inspiration correct?	Yes ☐	No ☐

Analysis of structure around the lungs

Mediastinum
- In place? Yes ☐ No ☐
- Normal? Yes ☐ No ☐

Diaphragm
- In place? Yes ☐ No ☐

Pleura
- In place? Yes ☐ No ☐

Analysis of lung parenchyma

Parenchyma
- Parenchyma: Normal ☐ Abnormal ☐
- If anomalies: Unilateral ☐ Bilateral ☐

If condensation
- Single ☐ Several ☐
- Homogeneous ☐ Not homogeneous ☐

If cavitation
- Unique ☐ Multiple ☐
- Thick wall ☐ Thin wall ☐

Retraction Yes ☐ No ☐

Cardiomegaly Yes ☐ No ☐

Draw the anomalies

Hypotheses

Anomalies(s) evocative of:
- Pneumonia ☐ Active tuberculosis ☐
- Pleurisy ☐ Sequelae ☐
- Other ☐

Conclusion	Taking clinical and biological findings into account

Chapter 5: Investigation of an acute public health problem: An outbreak of suspicious rice wine poisoning in Cambodia, 2023

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Preface

Rationale

This chapter reports an event from a suspected outbreak of methanol poisoning. This study is the third of four projects required to satisfy Master of Applied Epidemiology (MAE) program qualifications. The investigation was led by the Cambodia Communicable Disease Control Department (CCDC) in collaboration with the Provincial Health Department, Pursat Province, Cambodia.

Prior to joining the outbreak investigation, approval from Dr. Sovann Ly, Director of the Cambodia CDC, and Dr. Sengdoeun Yi, Deputy Director of the Cambodia CDC, was obtained to allow my participation in the field investigation and response as a learning opportunity. I would also like to express my gratitude to Mr. Puthik Longhay (ANU ASEAN MAE Scholar 2022) for keeping me informed about the outbreak, as well as to Dr. Seng Sopheavy for helping and supporting me to manage the field mission.

Roles

Dr. Seng Sopheavy, Principal Investigator, permitted me to do the following tasks:

1. Discussions on and generation of questionnaire
2. Interviewing cases and controls
3. Assisting with data analysis
4. Writing the outbreak report

Acknowledgement

The authors express their gratitude to:

- Pursat PHD: Director, Rapid Response Team (RRT), provincial hospital staffs, Krakor Referral hospital staff
- Field Epidemiology Training Program (FETP)-Manager
- FETP-Trainees and Mentors

- FETP-Trainee from ANU

- Local authorities such as Health Center (HC)

Lessons learned

Since I started working in the Epidemiology and Public Health Unit at Institut Pasteur du Cambodge approximately ten years ago, I have participated in outbreaks of avian influenza A/H5N1, Chikungunya, and Human Metapneumovirus. During this current outbreak, I have had the opportunity to participate more effectively as I have enhanced skills from undertaking the MAE.

My participation in the investigation of the outbreak has given me knowledge and skills that will allow me to contribute more effectively to responding to future outbreaks.

1. Teamwork: Collaboration is essential for outbreak investigations because it maximises the team's collective expertise, efficiency, and efficacy, resulting in improved disease control and prevention outcomes.

2. Communication and coordination: Investigations of *outbreaks* require numerous parties, including healthcare facilities, laboratories, government agencies, and the public. Effective collaboration ensures that team members share information, make decisions collaboratively, and coordinate actions through clear and timely communication.

Acknowledging limitations: Human and/or food specimens were not collected during the course of the investigation, generating several limitations and challenges. Epidemiological research can help us identify risk factors, but it does not always enable us to draw definitive conclusions about the source of the outbreak.

Public Health Impact

We were able to quickly stop the outbreak in the community, and lessons learnt should help reduce future outbreaks.

Abstract

Background: The Provincial Health Department (PHD) of Pursat sent a report of alcohol intoxication in Moatprey Village, Kampong Pou commune, Krakor district, Pursat province, Cambodia, to the Cambodia Communicable Disease Control Department (CDC) on June 2, 2023. There had been one death, and 27 people had also become unwell with headaches, vomiting, shortness of breath, blurred vision, dizziness, palpitations, abdominal pain, seizures, and nausea without diarrhoea, as well as chest pain and agitation after consuming alcohol before and during the funeral. The suspects were admitted to Krakor Referral Hospital and Pursat Provincial Hospital. According to history, the PHD was suspicious of a potential alcohol poisoning incident. Methanol poisoning from rice wine is a common occurrence in Cambodia and presents a significant public health risk. We conducted an investigation to verify the outbreak, diagnose the cause, identify the transmission source, and implement preventative and control measures.

Method: The investigation included a case-control study in which suspected patients were compared to non-cases without symptoms. The patients were interviewed by the response team, however, while rice wine samples were collected from suspected sources and sent for analysis, methanol analysis was not performed on blood and urine samples from suspected cases. A suspect case was defined as any individual who presented clinical symptoms such as blurred version or palpitation or shortness of breath and one of the following symptoms like nausea, vomiting, dizziness, agitation, asthenia, headache, seizure, chest pain, or diarrhea and had a history of rice wine consumption within five days prior to the onset of symptoms, as well as undertaking excessive alcohol consumption during the ceremony. A confirmed case was defined as any suspected case who had laboratory confirmed methanol in blood or urine.

Results: Several drinking festivities in the village of Moatprey resulted in 27 suspected cases and one death. Krakor and Pursat hospitals admitted all suspected individuals with symptoms such as headache, vomiting, and dizziness, but no diarrhea, chest discomfort, or agitation. Most of the cases (85.7%) were males between the ages of 24 and 63. Alcohol consumption occurred between June 29th and June 31st, 2023. We examined four rice wine samples and found that the ethanol concentration ranged from 20.7% to 25%, with no presence of methanol. The inquiry did not perform methanol testing on patient samples due to the absence of collected blood and urine samples.

Conclusion: The incident of excessive alcohol consumption in the Moatprey village was effectively managed. No food sources were examined, or human samples collected as the Outbreak team. Based on the historical data and the signs and symptoms exhibited by the patients with the assumption of the doctors from the hospitals, that the outbreak was attributable to excessive alcohol drinking (Risky alcohol intake is common in the village where we collected the information). Suitable control and prevention measures, including health promotion and collaboration with the local authorities. Through collaborations with multiple agencies and cooperation with Health Center, PHD and Cambodian DCC, significant progress was made. Continuous alcohol product monitoring and health promotion are essential to prevent a similar incident from occurring in the future. Additionally, no food sources, urine and blood samples were not tested.

Abbreviations

ANU	Australian National University
CCDC	Cambodia Communicable Disease Control Department
CDC	Communicable Disease Control Department
FETP	Field Epidemiology Training Program
HC	Health Center
IPC	Institut Pasteur du Cambodge
MAE	Master of Applied Epidemiology
NHQC	National Health Production Quality Control Center
OD	Operational District
PHD	Provincial Health Department
RRT	Rapid Response Team

5.0 Introduction

Toxic alcohol poisoning (methanol, ethylene glycol, isopropyl alcohol, diethylene glycol, and propylene glycol) can result in cellular dysfunction and mortality (1). However, the symptoms lack specificity with a higher probability of incurring fatal harm to bodily organs and mortality (2). Accidental epidemic methanol intoxication occurs frequently, most likely due to distillation and fermentation errors or contaminated liquids (3,4).

At 10:00am On June 2nd, 2023, the Pursat Rapid Response Team, Pursat Province, reported 16 cases of suspected methanol intoxication after attending a funeral in Moatprey Village, Kampong Pou commune, Krakor district, Pursat province to Communicable Disease Control Department (CDC) of the Ministry of Health (MoH) of Cambodia. The suspected outbreak resulted in 28 suspect cases, including one fatality, over the course of one day between the ceremony on Thursday, June 1st, and Friday, June 2nd, 2023.

Methanol poisoning outbreaks occur when methanol is added to illicitly or informally produced drinks with alcohol. Mortality from methanol overdose is rare. However, it may result in abnormal metabolic processes, lack of vision, permanent neurologic disability, and death. Methanol converts to formic acid when consumed. It can also be difficult to diagnose because of transient metabolites.

Methanol poisoning is a common cause of foodborne outbreak in Cambodia. According to a recent report in 2023 from the Cambodian CDC, among the 44 foodborne outbreaks reported since 2019, the majority of events (30%) were caused by methanol intoxication, with 74 deaths over 389 reported cases (From Cambodian CDC line list report).

The last reported methanol outbreak in Pursat Province occured in June 2021 at Sansor village, Ornsa Jambok commune, Krakor District with 101 reported cases and 10 deaths (From Cambodian CDC line list report).

Ethical approval

Due to the need for prompt public health action, ethical approval was not required as part of the governmental response to outbreak investigation. Investigations of outbreaks are conducted in accordance with national and regional public health statutes, and oversight by an Ethics Review Board is not required. The approval of the Australian National University

Human Research Ethics Committee (2017/909) was obtained for publication purposes in this investigation.

5.1 Methods

The team followed the Cambodian CDC and the Ministry of Health managing the outbreak. The Operational District (OD) received information from the Health Center on June 2nd, 2023, and was alerted to identical cases reported in Moatprey village, Kampong Pou commune, Krakor district, Pusat province on the same day. Upon receiving notification, the Rapid Respond Team (RRT) activated as a rapid assessment team. To facilitate the epidemiological investigation, a case definition was generated (see below). As soon as the outbreak was verified and confirmed, the RRT coordinated and managed the outbreak. The investigation began on June 2nd, 2023, and concluded on June 3rd, 2023, due to no additional cases being identified or reported. During the investigation, a case control study was conducted, comparing suspected patients to non-cases who did not show any symptoms.

Case Definition

A suspected case was defined as anyone with blurred vision or palpitations or shortness of breath, in addition to one of the following symptoms: nausea, vomiting, dizziness, agitation, lethargy, headache, seizure, chest pain or diarrhea with symptoms occurring between May 27th 2023 to June 2nd 2023 and who were residents in or visitors? (Only residents there no visitors) to Moatprey village, Kampong Pou commune, Krakor district, Pursat province.

Epidemiology Investigation

The local Rapid Response Team (RRT) was notified by the local authorities at the village after the death of a case on June 2nd, 2023. The RRT team conducted a brief interview with each of the 28 cases. Six patients with suspected critical diseases were transferred to Pursat Referral Hospital, while an additional twenty-two patients were admitted to Krakror District Hospital. The RRT team collected rice wine from the funeral place, a shop and producer place. From June 2nd to 3rd 2023, the Cambodia CDC and MoH, PHD, HC, and Institut Pasteur du Cambodge (IPC)/ANU conducted a collaborative study. The team conducted 27 active suspected cases at the hospitals and throughout the village (Appendix 5.1). Also, all other authorities were aided in notifying any additional suspicious cases. During the investigation period, appropriate control and preventative measures were implemented to manage the event.

We conducted observations and interviews with rice wine producers to gather additional information. During active case detection, demographic information, clinical details, and alcohol consumption history were collected (See appendix 5.3).

Laboratory testing

Rice wine samples collected by the RRT during initial investigations were sent to a National Health Production Quality Control Center (NHQC) laboratory in Phnom Penh for methanol analysis. No blood and urine samples were collected from hospitalised patients for methanol analysis.

Data management

Data was collected from interviewed suspect cases using a Google form, then a line listing of the information collected for all notifications was compiled and exported into STATA 18 (Stata Corp., Texas, United States) software for analysis. The distribution of cases was explained using descriptive analysis.

5.2 Result

Descriptive epidemiology

After the initial notifications in the village of Moatprey, all drinking ceremonies/parties had occurred with a total 28 suspected cases and one fatal case. A total of twenty-eight individuals showing symptoms consistent with the above-mentioned suspected case were admitted to Krakor and Pursat hospitals. The map and timeline of the events are shown in Figure 5. 1. The first case was reported on June 2nd, 2023, (Figure 5. 2).

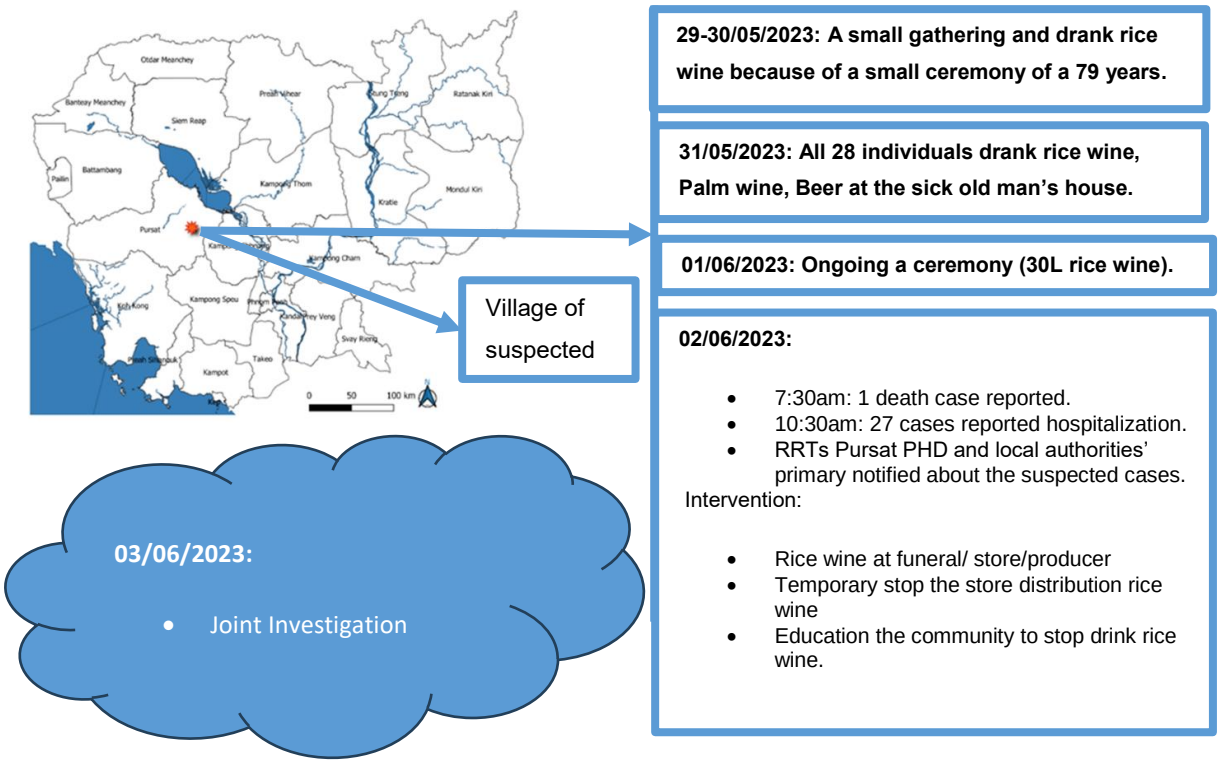

Figure 5. 1. Location of the village of suspected methanol outbreak and timeline of events, Moatprey village

In total, 28 individuals from the village of Moatprey were hospitalised as potentially suspected cases. Only 8 of the 28 potentially suspected (Figure 5. 2). Socio-demographic characteristics of suspected cases are tabulated in Table 5. **1**.

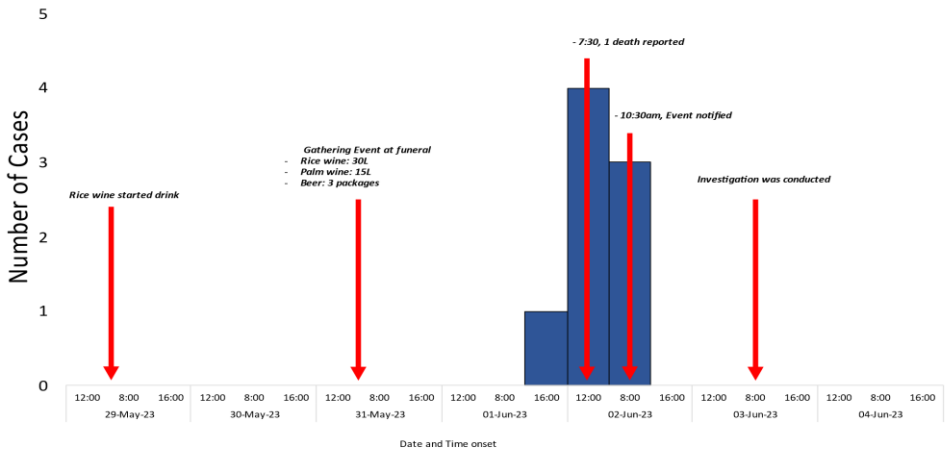

Figure 5. 2. Distributions of symptoms among sick cases by date and time onset from 29 May to 03 June 2023, Moatprey village (n= 8)

Of the suspected cases, there were 24 men (85.7%) and 4 women (14.3%), with ages ranging from 24 to 63 and a mean age of 41.6(SD +/-9.6) years. Consumption of alcohol occurred between June 29th and June 31st, 2023. Figure 5. 3 details the distribution of symptoms among the suspected cases.

Table 5. 1. Social demographic characteristics among suspected cases from 29 May to 03 June 2023, Moatprey village (n=28)

	Characteristics	**Suspected cases(n=8*)**	**Non- suspected cases(n=20)**	**Total**
Age	24-33 years	1(12.5)	5(25.0)	6(21.4)
	34-43 years	1(12.5)	12(60.0)	13(46.4)
	44 years≤	6(75.0)	3(15.0)	9(32.1)
Gender	Male	8(100.0)	16(80.0)	24(85.7)
	Female	0	4(20.0)	4(14.3)
Occupation	Farmer	8(100.0)	20(100.0)	28(100.0)

*Sicked cases with symptoms

Most sick cases had multiple symptoms, including headache, vomiting, shortness of breath, blurred vision, dizziness, palpitations, abdominal pain, seizure and nausea. No sick cases complained of diarrhea, chest pain, or agitation (Figure 5. 3 and Table 5. 2).

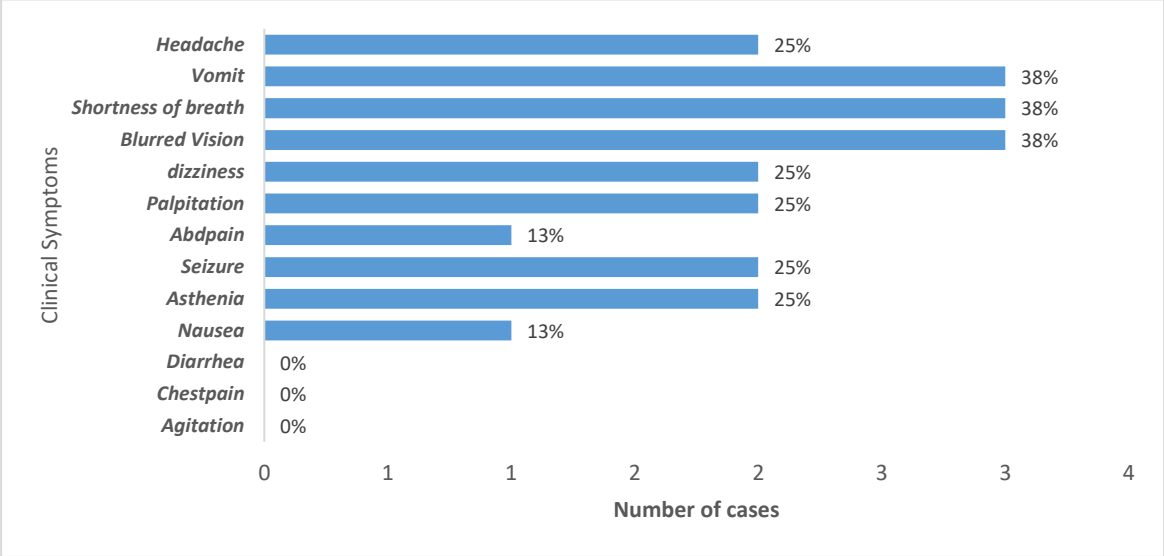

Figure 5. 3. Frequency symptom of suspected cases from 29 May to 3 June 2023, MoatPrey villages (n=8 Cases)

Table 5. 2. Distributions of signs among suspected cases from 29 May to 3 June 2023, MoatPrey villages (n=8)

Signs		N (%)
Gastrointestinal signs	(Any symptoms)	3 (37.5)
	Nausea	1 (12.5)
	Vomit	3 (37.5)
	Abdominal pain	1 (12.5)
Central Nervous System signs	(Any symptoms)	7 (87.5)
	Headache	2 (25)
	Asthenia	2 (25)
	Dizziness	2 (25)
	Shortness of Breath	3 (37.5)
	Seizure	2 (25)
Palpitation		2 (25)
Blurring of visions		3 (37.5)

The village ceremony began, and all 28 individuals drank rice wine. We also interviewed the producer about how to make rice wine, as depicted in Figure 5. 4. First, the rice and yeast were placed in the same container. Secondly, combine the rice and yeast. Add water to the mixture in the third step. Fourth, let it absorb for three to five days in a mixed container. Then, Burn the fermented mixture. The final product was delivered with the first product containing 60 degrees of alcohol and the second product containing 30 degrees of alcohol.

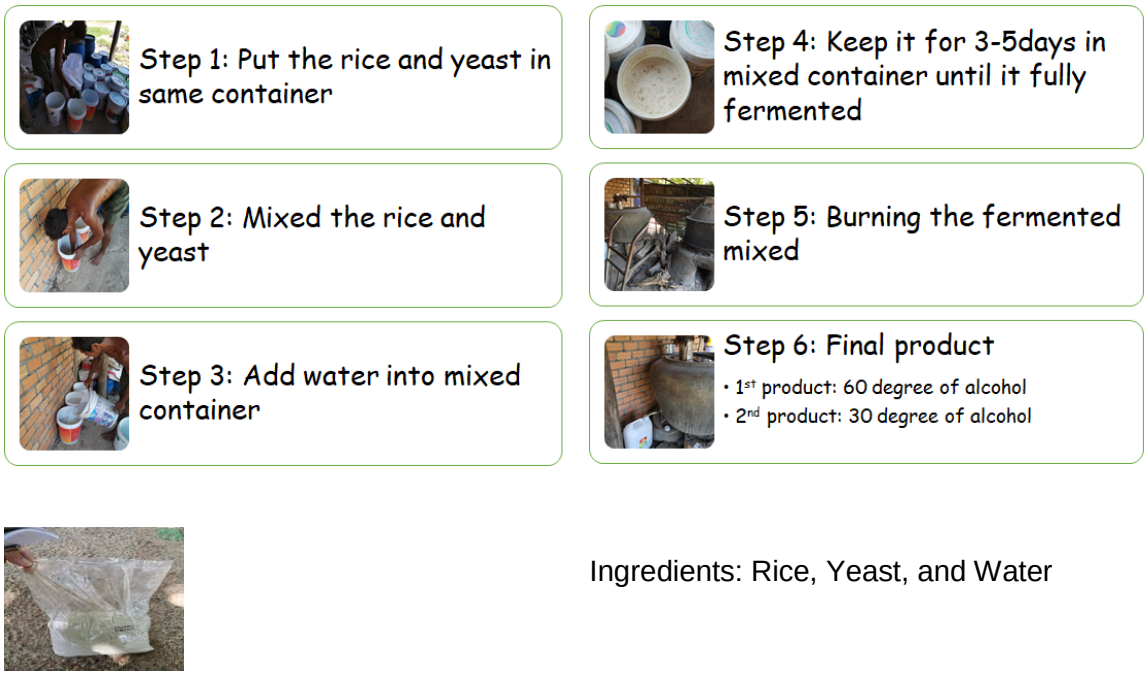

Figure 5. 4. The steps to produce rice wine in the village

Laboratory results

The RRT and authorities collected four samples of rice wine from the funeral home (200ml), store (120ml), production site (140ml), and mixed rice wine from the store (120ml). None of the results contained methanol. However, we discovered ethanol ranging from 20.7% to 25%. Methanol analysis results are listed in Table 5. 3 below with the process of collection in Appendix 5.2. Methanol analysis of patient blood and urine was not performed as samples were not collected during the course of the investigation.

Table 5. 3. Result of samples obtained from the NHQC/MoH

Sample ID	Source	Amount	Date of Result	Result
1	Rice wine from funeral	200ml	4/06/2023	Methanol: No Ethanol: 25.3%
2	Rice wine from the store	120ml	4/06/2023	Methanol: No Ethanol: 20.7%
3	Rice wine from product place	140ml	4/06/2023	Methanol: No Ethanol: 22.4%
4	Mixed rice wine from the store**	120ml	4/06/2023	Methanol: No Ethanol: 21.9%

**Mixed wine: the combination of rice wince with some kind of traditional medicine.

5.3 Discussion

1) Cambodian Rice Wine - Sra Sor

From the Khmer Empire, this technique became widespread among the wealthy and famous and everyone else. The refined potion has been used in religious rites and festivals, demonstrating its historical value in Cambodian society (5). One of Cambodia's earliest handmade alcoholic beverages is rice wine, or Sra. It is associated with family gatherings, farmers, and city workers. It claims health advantages yet causes hospitalisations and fatalities. Rice wine is still the main alcoholic beverage in rural areas and almost every Cambodian has their family roots in the countryside. Therefore, it is still relevant, especially during events such as Khmer New Year when people return to their provinces," the company said (6). Furthermore, rice wine is usually 20% to 50% alcohol. East, Southeast, and South Asian cuisine uses rice wines in formal meals, parties, and cooking (5,7). Furthermore, the Cambodian Guidelines for rice wine production, as stated by the Department of Agro-Industry under the Ministry of Agriculture, Forestry, and Fisheries, do not specify the specific amount of ethanol used in the production process of rice wine in Cambodia (8).

2) Alcoholism and alcohol poisoning in Cambodia

The village of Moatprey in Cambodia recently experienced a suspected outbreak of methanol poisoning after a funeral where locally made rice wine was served. Over the course of two days, 28 people reported feeling unwell after drinking the rice wine, with 8 becoming seriously ill and one death.

Previous reports of methanol outbreaks in Cambodia are commonly linked to the consumption of rice wine (9). In rural areas, rice wine is popular at gatherings such as funerals, weddings, and housewarming parties (10,11). Methanol is diluted in rice wine and sold or produced by rice wine vendors or manufacturers. Rice wines are reasonably priced (12). Nevertheless, the tests did not reveal higher levels of ethanol in the samples of rice wine, which could not contribute to making individuals ill. Anecdotally, all suspected cases were consumed a lot of alcohol every day. In addition, it should be noted that palm wine, beer, or mixed wine were not included in the sample collection for testing purposes.

Local health authorities responded quickly to contain the event. Patients were sent to hospitals for treatment, and active case detection took place in both the village and hospitals to identify

new cases. Rice wine samples were collected and tested to confirm high methanol levels. Doctors closely monitored patients' conditions and collaborated across departments and organisations. Health education and enforcement activities were also implemented to prevent future occurrences.

The PHD's response to the outbreak was successful because of the collaboration between multiple organisations. Case management, health education, police reports and investigations, and enforcement activities constituted preventive and control measures. Case management included both clinical and administrative functions at the hospital, as well as active case detection at the hospitals and village, but there were no cases in the community. Samples were sent to confirm the methanol content. Doctors in hospitals were responsible for notifying each department of any changes in the patients' conditions. Figure 5. 2 summarises the major events that developed.

While the outbreak highlighted the dangers of improperly made alcohols, authorities were able to successfully manage the cases and mitigate the public health impacts through coordinated efforts and community engagement. However, more work is likely needed to address the root causes that lead to methanol adulteration and consumption of illegal alcohols in Cambodia's rural communities.

Limitations

There was no food, palm wine, beer, or mixed wine available from the gatherings to analyse for potential contaminants. No biological tests were performed on the patients, limiting the ability to rule out methanol poisoning versus ethanol intoxication, and the assumption was made by the investigating team you were assisting.

Recommendations

CCDC and MoH:

- Implement alcohol education programs in schools to teach students about responsible drinking and the risks of alcoholism.
- Increase access to addiction counselling and recovery services in rural communities.
- Work with Buddhist temples and local leaders to address cultural factors that promote excessive alcohol use.
- Encourage provision of healthy non-alcoholic beverages at social gatherings

- Conduct community outreach on the impacts of alcoholism on families and health
- Develop alcohol-free recreation spaces and activities to prevent initiation of drinking among youth.
- Promote workplace policies that prohibit drinking and support treatment and recovery.
- Increase alcohol taxes and regulate marketing and availability to make it less affordable and accessible.
- Build capacity among healthcare workers to screen for alcohol abuse and provide brief interventions.
- Expand treatment options like cognitive behavioural therapy and medications to support long-term recovery.

Pursat Provincial Health Department:

- Increase coordination between relevant sectors like police, hospitals, and local government through regular meetings and joint response protocols
- Develop a rapid communication system with the national level to expedite sample transport and confirmatory testing during outbreaks
- Implement education campaigns in villages on alcohol toxicity risks, safe alcohol production methods, and food hygiene
- Conduct routine surveillance for alcohol poisoning cases and tainted alcohol samples

Hospitals:

- Test blood gases and bicarbonate in all suspected alcohol poisoning cases to aid diagnosis and clinical management
- Quickly admit and monitor severe cases in hospitals for intensive treatment.
- Maintain active surveillance for additional cases to detect potential outbreaks.

Health Centers:

- Refer severe cases to hospitals for treatment while monitoring mild cases
- Educate community on signs of alcohol poisoning and when to seek medical care
- Report any increases in cases to provincial health department.

Communities:

- Improve awareness of methanol poisoning risks and proper fermentation processes
- Self-monitor and account for suspect cases in the village
- Immediately refer concerning cases to health facilities for evaluation
- Avoid consuming homemade alcohols from uncertain sources.

- Report any unsafe alcohol production to local authorities

5.4 Conclusion

Based on the details available, this outbreak was likely not caused by methanol poisoning, but it is the excessive drinking of alcohol. The etiology is supported by the findings from rice wine analysis and the symptoms and outcomes described by the hospital. The outbreak team did not examine food or other alcohol sources or collect samples from patients, relying on historical data and observed signs and symptoms to attribute the outbreak to alcohol poisoning. However, the public must still be made aware of the risks of methanol and ethanol. This epidemic of excessive drinking was precipitated by excess alcohol consumption containing high ethanol levels. Possible factors included the type and number of intoxicating beverages ingested and villagers' lack of awareness.

Collaborative efforts between local government, public health departments, hospitals, the CCDC, and the MoH were able to overcome these challenges. For future events, we recommend collecting food and other alcoholic beverages, as well as biological samples from patient samples, for analysis and examination. While this outbreak was not definitively caused by methanol, it highlights the dangers of overconsumption of alcohol as well as the need for continued vigilance, education, and multi-sectoral cooperation in rural communities.

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Appendix 5.1: Pictures from the field investigation

Appendix 5.2: Environmental situation and rice wine consumption

Environmental Study

- Funeral House
  - About 2km from the store
  - Gathering Event: 29-31/05 to 01/06/2023
  - Participants about 20persons
  - Wine
    - Rice wine: 30L remain 15L (1 store only)
    - Palm wine: no remain
    - Beer 3 package: no remain
  - Food:
    - Grill catfish, boiling pork, poor ice, grill pork with sugar and rice

- Rice wine store
  - Generally,60L/3days
  - Rice wine from one source producer for many year (never have any problem)

- Death Case house
  - drank wine everyday (1L/day)
  - had no any chronic disease
  - No more rice wine remained at his house
  - About
  - 29-31 May to 01 June 2023 drank a lot rice wine
  - 02/06/2023:
    - Severe headache, abdominal pain, vomiting and hypotonia and death at home

- Rice wine producer
  - ChekChao village
  - About 3km from the store
  - Normally produce 45L/day
  - Provide to store mostly and remain some for some stores atChekChao village

Appendix 5.3: A questionnaire (Google form)

កំរងសំណួរអង្កេតស្រាវជ្រាវករណីរពុលអាហារ នៅភូមិ មាត់ព្រៃ ឃុំកំពង់ពោធិ៍ ស្រុកក្រគរ ខេត្តពោធិ៍សាត់ ខែមិថុនា ឆ្នាំ២០២៣

* Indicates required question

1. Interview ID *

2. Interviewer name *

3. Date Interview *

Example: January 7, 2019

Demography Data

4. Interviewee name *

5. Sex *

Mark only one oval.

- Male
- Female

6. Age (year) *

7. Village ? *

8. Commune? *

9. District ? *

10. Province? *

11. Occupation? *

12. Phone Number?

Symptoms

13. Have you been sick since 27 June, 2023? *

Mark only one oval.

- ◯ Yes
- ◯ No

14. Did you have any symptom

Check all that apply.

- ☐ Shortness of Breath/ពិបាកដកដង្ហើម
- ☐ Blur vision/ព្រិលភ្នែក
- ☐ Palpitation/ញ័រទ្រូង
- ☐ Blindness/ងងឹតភ្នែក
- ☐ Vomiting/
- ☐ Nausea
- ☐ Asthenia
- ☐ Seizure
- ☐ Tremblement/ញ័រដៃរជើង
- ☐ fatigue/វិលមុខ
- ☐ abdominal pain
- ☐ Headache
- ☐ diarrhea
- ☐ Other: _____

15. Time onset

_____

Example: 8:30 AM

16. Data onset

_____

Example: January 7, 2019

History before get sick

17. Did you joint any events? *

Mark only one oval per row.

	Yes	No
Stay Funeral on 31May 2023	◯	◯
Funeral on 01June 2023	◯	◯
Other party	◯	◯

Exposers

18. Did you drink ? *

Mark only one oval per row.

	Yes	No
Rice wine	◯	◯
Beer	◯	◯
Palm wine	◯	◯
other	◯	◯

19. ដេកនៅថ្ងៃណា?

_____

Example: January 7, 2019

23. បានហូបអាហារមួយចំនួនដូចខាងក្រោម៖ *

Mark only one oval per row.

	Yes	No
ហូបគ្រីអាំង/បំពង	◯	◯
ទឹកគ្រីស្វាយ	◯	◯
ទឹកគ្រីអំពិលទុំ	◯	◯
សាច់ជ្រូកស្ងោរ	◯	◯
បបរ	◯	◯
Others	◯	◯

Medical past history

20. ជីកនៅម៉ោងប៉ុន្មាន?

_____

Example: 8:30 AM

21. ជីកស្រាប៉ុន្មាននាក់?

_____

22. ជីកស្រាបរិមាណប៉ុន្មាន?

Mark only one oval.

- ◯ <250ml
- ◯ 250-500ml
- ◯ >500ml-750ml
- ◯ >750-1000ml
- ◯ >1000ml
- ◯ Don't know
- ◯ Other: _____

24. តើអ្នកមានជម្ងឺប្រចាំកាយដូចខាងក្រោមដែរឬទេ? *

Mark only one oval per row.

	Yes	No	Unknown
ជម្ងឺសួត	◯	◯	◯
ជម្ងឺរបេង	◯	◯	◯
ទឹកនោមផ្អែម	◯	◯	◯
លើសឈាម	◯	◯	◯
ជម្ងឺឆ្អឹម	◯	◯	◯
ជម្ងឺតំរងនោម	◯	◯	◯
មានផ្ទៃពោះ	◯	◯	◯
Others	◯	◯	◯

25. បានប៉ះពាល់ថ្នាំពុលកសិកម្ម ? *

Mark only one oval.

◯ Yes
◯ No

Seeking Care

26. ***ចាប់ពីថ្ងៃទី ២៧ ខែ ឧសភា ឆ្នាំ២០២៣មក*** តើអ្នកបានទទួលសេវាថែទាំសុខភាពដូចខាងក្រោមដែរឬទេ? *

Check all that apply.

- [ ] OPD/ពិគ្រោះជំងឺ
- [ ] Provincial Hospital
- [ ] Krakor hospital
- [ ] Privet Clinic
- [ ] Home
- [ ] Other: _____

27. សម្រាកពេទ្យថ្ងៃណា?

_____

Example: January 7, 2019

28. ម៉ោងសម្រាកពេទ្យ?

_____

Example: 8:30 AM

Chapter 6: Teaching and capacity building

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Abbreviations

CDC	Cambodian Center for Disease Control
IFETP	Intermediate Field Epidemiology Training Program
IPC	Institut Pasteur du Cambodge
KAP	Knowledge, Attitude, and practice
LFF	Lessons From the Field
MAE	Master of Applied Epidemiology
MoH	Ministry of Health

Preface

Through my Field Placement at Institut Pasteur du Cambodge (IPC), I have been able to manage and contribute to my skills and knowledge of teaching and in capacity building opportunities in Cambodia.

This chapter illustrates my activities in preparing and facilitating teaching, peer-to-peer learning, and capacity development tasks as a required essential skill for public health professionals and field epidemiologists.

I completed the two core teaching requirements of the Master of Philosophy in Applied Epidemiology (MAE) program by:

- Preparing and conducting a Lessons from the Field (LFF): Developing a Study Protocols for Intermediate Field Epidemiology Training Program (IFETP) (See Appendix 6.1 and pictures in Appendix 6.2.

- Preparing and conducting a lesson from the field (LFF): Conducting a knowledge, Attitude, and practice (KAP) Survey in Live Bird markets, Cambodia (Appendix 6.3)

I describe a selection of additional teaching and capacity-building activities I have conducted as an MAE scholar, emphasizing my role and the lessons I have learned from these endeavors.

Teaching Session of Intermediated Field Epidemiology Training Program (IFETP) students

Before the course block 3, with supported by CDC, MoH (Dr. Yiseng Doeun and Mr. Puthik Long Hay) I was invited to deliver a face-to-face teaching lesson on Developing a Study Protocol for Intermediated Field Epidemiology Training Program (IFETP) at Cambodian Center for Disease Control (CDC), MoH, Mr. Puthik Long Hay (MAE scholar 2022 was also a facilitator during this session. Due to the lesson of this session prepared by the IFETP program, I followed the Study Protocol lesson created and applied my experience during what I have learned from MAE. This experience would be a valuable introduction for the IFETP students.

The three hours and a half training session included an introduction to the objective and purpose study protocols, teaching including the case study of the protocols in different settings,

feedback to a group, which culminated in a summary of all the ideas and lessons learned. The following was a digital evaluation. Within the scheduled three hours, the entire course was taught.

My role

- Conducted teaching for all the students.
- Prepared prompts for discussion
- Ensured that all students had the opportunity to participate in the discussion in this context of Cambodia.

Student feedback

At the conclusion of the class, I requested the students to complete a brief online evaluation. A Likert scale was used to signify the level of accord regarding the lesson's facilitation, utility, and originality. A mean score was calculated (1= Poor, 4 = Excellent) with the total number of nine below report after the session. Responses included:

To what extent do you feel the following objective was met? The responses indicated that 11.1% (n=1) were excellent and 88.9% (n=8) were very good.

To what extent do you feel the following objective was met: Facilitators? According to the responses, 33.3% (n=3) were rated as excellent and 66.7% (n=6) were rated as very good.

Do you feel that your knowledge or skills have improved by taking this session? According to the responses, 11.1% (n=1) were rated as completely improved, 66.7% (n=6) were rated as largely improved and 22.2% (n=2) was partly improved.

In the open-text field asking for the most valuable thing that the trainees learned from this secession, the following were among the responses:

More Idea how to write introduction, ethical issues concerned, method.

All components

The component of study protocol

The concept of define problem statement.

How to prepare protocols

Her explain that is very good for learning this lesson. She can manage time well during training.

The open-text recommendations section contains the following constructive comments:

More detail about all point of protocol

Additional explains on problem statement.

Explain clearly step by step in each session.

Give more practical doing from teacher's experiences more.

Lessons learned

Following the lesson delivery, I reflected that the lesson's content and structure were effective, but that additional time for student discussion and feedback was necessary. I especially enjoy the students' experiences.

If I were to teach this lesson again, I would incorporate teamwork through practice and the sharing of group work at the conclusion of the lesson.

6.1 Lessons From the Field

Lesson background

I delivered by my LFF to MAE peers on 'Conducting a knowledge, Attitudes, and practice (KAP) Survey in Live Bird markets, Cambodia.' I chose this topic because I thought it would be interesting to provide MAE students with information on processes in preparation for fieldwork in a specific setting in Cambodia. My epidemiological study undertaken at Live Bird Markets in Cambodia provided a unique topic to deliver to my colleagues, to show the process and challenges in undertaking fieldwork at Live Bird Markets in Cambodia. This was such a valuable learning experience for me. The assumption of this session is how we can implement complex tasks in fieldwork settings in Cambodia. I particularly enjoy my teaching and facilitation skills, as well as to determine if this learning style is appropriate and appreciated by others. I designed a presentation that reflected my personal preferences.

Teaching strategy

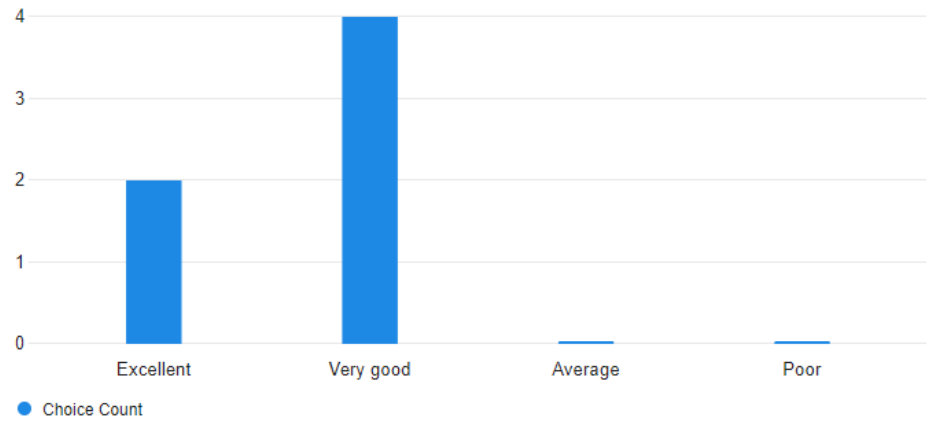
I conducted my LFF using PowerPoint slides to present:

- I informed MAE students that I would share my experience in Cambodia, as some MAE students have never had this experience before.
- I presented information including photos and documents to highlight the field work setting.
- I undertook a reflection at the end of the session where I summarised the LFF by relating the context and exploring how we could implement.
- I encouraged and allowed MAE students to ask questions.

Evaluation

I provided an opportunity for my MAE peers to review my LFF teaching. The evaluation questions and responses are shown below.

To what extent do you feel the following objective was met (contents of the sessions)?



What was the most valuable thing that you learned from session?

How processes are different in other parts of the world.

The process of ethics approval in Cambodia. I also like the photos taken during data collection in the markers.

Logistical considerations for surveys in Cambodia.

It is important to develop good relationship with the study participants before we can interview them.

Survey practices, it takes time to create questions that will give clear results in the data.

Challenges obtaining ethics across international settings.

If this session was delivered again, is there anything that you would suggest doing differently next time?

Nothing. I loved the pictures and the opportunity to ask lots of questions about your experiences.

It was all good. I think it will be good to mention the key challenges and lessons in the approval process mainly from ANU. Otherwise, it was excellent.

I would have loved to know more about the questions you asked in your interview and your results.

None

No other suggestions. It was interesting.

Great session

Lessons learned

I was delighted to receive such positive feedback and to learn that my colleagues found the session valuable. I enjoyed response their questions and such a meaningful discussion together.

6.2 Other training sessions

In addition to my work on the MAE project in IPC, I have committed to providing ongoing support for Virology and Epidemiology and Public Health Units. It is essential to me to continue providing support to colleagues during this field placement. I have provided training and supervision in the fieldworks:

- In May 2022: I assisted Dr. Erik Karlsson, Deputy of the Virology Unit (one of my field supervisors) on a research project titled:" Surveillance of Influenza in Humans, Swine, and Poultry, Cambodia, 2022".

- In November 2022, I assisted Benjamin Louis Sievers, a Master Scholar, with the study title "Knowledge and attitudes towards measles vaccination in families living in the floating village of Prek Toal 2023".

- In December 2022 and January 2023: I assisted Dr. Erik Karlsson, Deputy of the Virology Unit (one of my field supervisors), with the research" Surveillance of Influenza in Humans, Swine, and Poultry, Cambodia, 2023".

- In July 2023: I assist Frida Esther Sparaciari, a PhD candidate at James Cook University, with her research "Knowledge, attitudes, and practices to apply effective communication strategies, risk mitigation measures and prevention in LAMs before, during and after the festivities in 2023-2024".

I prepared, supervised fieldwork and training of interviewers in the use of the questionnaires. I appreciated the opportunity to consider project management critically. I examined which aspects of project management are essential for organised and accountable management (regardless of context) and which are difficult activities or tools that are inappropriate or impracticable in this context. I was also able to share insights gathered from administering a number of my own projects through MAE, such as how to modify project milestones in response to unanticipated barriers.

Appendix 6.1: Teaching intermedia IFETP material

Field Epidemiology Training Program – Intermediate
Standard Curriculum

Study Protocols

April 2017

Objectives

- List the elements of a problem statement
- Describe the purpose of a study protocol
- List the basic sections of a protocol
- Critique a protocol

Study Protocols 2

Session Overview

- Purpose of study protocols
- Components of a study protocol
- Common problems with protocols

Study Protocols 3

Purpose of Study Protocols

Study Protocols 4

What is a Study Protocol?

- Document to guide the implementation and execution of the study
- Written by the study investigators
- Created during the planning stage

Study Protocols 5

Why Do We Need A Study Protocol?

- To clearly define the problem and study goals
- To ensure that study design is appropriate for research objectives
- To plan the study and ensure that it is feasible
- To provide technical details on study organization and procedures
- To obtain approval of ethical committee(s) and define the roles of all partners

Study Protocols 6

A Study Protocol Must...

- Be clearly written so that it can be understood by the study investigators and technical staff
- Provide sufficient detail on study procedures in order to achieve consistent results

7

Study Protocols

Where to Start?

- Use a protocol checklist
  - www.cdc.gov/niosh/nas/mining/pdfs/Protocol%20Checklist.pdf
- Use examples from other studies
- Ask your Instructors for examples

8

Study Protocols

Components of a Study Protocol

9

Study Protocols

Study Protocol Outline

1. Title page
2. Abstract
3. Introduction
4. Problem statement
5. Study objectives
6. Methods
7. Ethical considerations
8. Timeline
9. Resources
10. References
11. Appendices

10

Study Protocols

Title Page

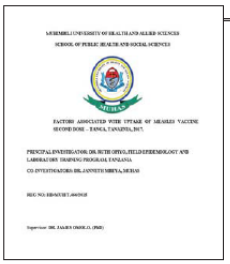
- Title
  - Concise and specific
- Investigators
  - List all investigators and their affiliations
  - List the institutions associated with the study
- One page in length

NB: May be specific guidelines for specific institutions

11

Study Protocols

Title Page (Example)



12

Study Protocols

Abstract

- Brief summary of the:
  - Problem
  - Study objectives
  - Methods to be used to address objectives
  - Expectations for how results will be used
- <1 page in length
- NB: *Not* the same as a manuscript abstract!

13

Study Protocols

Abstract (Example)

Brief summary of the:	
Problem	Childhood malaria is a problem in District X. The annual incidence of malaria among children<5 years in District X is 23/1000, with case-fatality rates of 9%. Bednets are widely available and free, and the reasons for the high rates of malaria are unknown.
Study objectives	We will evaluate risk factors for malaria and malaria deaths among children <5 years in District X.
Methods to address objectives	We will recruit children <5 years with confirmed malaria from Hospital Z, and compare them with age-matched children hospitalized for other reasons to identify malaria risk factors.
Expectations for use of results	These data will help us identify ways to reduce childhood malaria in District X.

14

Study Protocols

Introduction

- Background on the problem in the geographic region of study
  - Existing data about the problem in the area
- Brief review of *relevant* literature
- Justification and rationale for study
- 2-3 pages in length

15 Study Protocols

Problem Statement & Study Objectives

What is your problem? → How will you address it?

PROBLEM STATEMENT — OBJECTIVES

16 Study Protocols

There Are *Two* Problems in Every Problem Statement!

What is your problem? → How will you address it?

PROBLEM STATEMENT — OBJECTIVES

The Health Problem | The Knowledge Gap

17 Study Protocols

The Problem Statement: the Health Problem and the Knowledge Gap

Health Problem	The Knowledge Gap
People with new diagnoses of HIV are not being linked into care at our targeted rates	What factors (social, clinical, economical, etc.) influence linkage to care?
Many people in our population are dying of tuberculosis	We don't know how prevalent it is or in what populations it's most common
Measles-containing vaccine uptake is lower than the recommended target	What factors increase (or decrease) uptake of vaccines?
Although there is a law to wear safety belts, people are still dying in accidents without wearing the belt	What factors influence safety belt usage?

To resolve these…. We need to study these!

18 Study Protocols

The Problem Statement Needs to Address Both of These

- Describing the Health Problem includes:
  - A specific description of the problem and its magnitude in your setting, in person/place/time
  - A brief explanation of *why* it's a problem
  - A description of what it *should* be like (guidelines, national targets, etc.)
- Describing the Knowledge Gap includes:
  - A simple statement of what you don't know!
  - The overall objective of your study

19 Study Protocols

Example of the *simplest* problem statement

"Despite rollout of measles-containing vaccine in Country X during 2011, outbreaks of measles have continued. — Why it's a problem

Measles-containing vaccine coverage is targeted to be >90% among 5-year-old children in Country X. — What it *should* be like

However, a study during 2015 in District Y, showed coverage to be only 37% among children<5 years. — The health problem

The reasons for this poor coverage are unknown. — The Gap

We plan to evaluate reasons for low vaccine coverage in District Y." — Overall objective

20 Study Protocols

Other Things You Can Put in a Problem Statement

"Despite rollout of measles-containing vaccine in Country X during 2011, outbreaks of measles have continued. — Why it's a problem

Measles-containing vaccine coverage is targeted to be >90% among 5-year-old children in Country X. — What it *should* be like

However, a study during 2015 in District Y, showed children<5 years. — The health problem

e are unknown. — The Gap

ow vaccine — Overall objective

Literature review: Data from other studies suggesting reasons for poor vaccine uptake

Rationale: How the results of this study will benefit health in District Y

21 Study Protocols

Keep your problem statement to ~1 page or less!

Problem Statement & Study Objectives

What is your problem? → How will you address it?

PROBLEM STATEMENT — OBJECTIVES

22 Study Protocols

Study Objectives

- General objective (usually one)
  - Derived from the research question(s)
  - Specifically addresses the Knowledge Gap
- Specific objectives (usually 2-5)
  - First one: Determining magnitude of problem
  - Next ones: Specific subsets of the General Objective
  - Note: Specific objectives may not be necessary for descriptive studies

23

Study Protocols

General Objective: Examples

Health problem	The Knowledge Gap	General objective of your study
People with new diagnoses of HIV are not linked into care at our targeted rates	What factors (social, clinical, economical, etc.) influence linkage to care?	Determine what factors are associated with linkage to care
Many people in our population are dying of tuberculosis	We don't know how prevalent it is/ in whom it's most common	Determine the prevalence of tuberculosis in *X* population
Measles-containing vaccine uptake is lower than the recommended target	What factors increase (or decrease) uptake of vaccines?	Determine what factors are associated with vaccine uptake
Although there is a law to wear safety belts, people are still dying in accidents without wearing the belt	What factors influence safety belt usage?	Determine what factors are associated with use of a safety belt

24

Study Protocols

Specific Objectives: Example

- **General objective**: Determine what factors are associated with uptake of measles-containing vaccine in District Y — Specifically addresses Knowledge Gap
- **Specific objectives**:
  - Determine the uptake of measles-containing vaccine in District Y — Magnitude of problem
  - Determine the association between social factors (perception of the vaccine, SES, vaccination history, number of children, educational level, etc.) and uptake of vaccine
  - Determine the association between proximity to a vaccination site and vaccine uptake
  - Determine the association between eligible vaccine candidates' knowledge about the vaccine and uptake

  — Specific subsets of General Objective

25

Study Protocols

Methods

- Study design
  - *Cross-sectional, case-control, cohort, etc.*
  - *Analytic vs descriptive*
  - *Justification for that design: how will it help you answer the main research question(s)?*

- We hypothesize that participating in school sports will improve school performance in primary-school children in Dar es Salaam, Tanzania
- To test this hypothesis, we will conduct a ???? study

26

Study Protocols

Methods

- Study population
  - *Subgroups targeted*
  - *Geographic location*
  - *Reasons for selection (representativeness, accessibility)*
  - *Inclusion and exclusion criteria (who is eligible, who cannot participate)*

- School-enrolled children ages 13-15 in Dar es Salaam
- Current enrollment, and ages 13-15 years
- Use a school assembly period for recruitment and enrollment
- Consider role of teachers, administrators, parents
- Scheduled follow-up survey at one year after exams

27

Study Protocols

Methods

- Sampling
  - *Simple random, systematic random, convenience, etc.*
  - *Sampling frame, if appropriate*
  - *Recruitment and enrollment methods*
  - *Methods for follow-up / retention*
- Sample size
  - *Sample size or power calculations*
  - *Adjustment for non-response or loss to follow-up*
  - *Feasibility of recruitment of desired sample size*

28

Study Protocols

Methods

- Data collection
  - *Recruiting of participants*
  - *Self-administered questionnaires, interviews, clinical record reviews, etc.*
  - *Definitions of exposed/unexposed, outcomes, and key covariates – **very important, and be specific***

- Primary exposure = self-reported participation in at least one school sport during the school year, adapted from a Global Youth and Sports Survey (reference author Name, Year)
- Primary outcome = end of year exam score from school records
- Covariates = age, gender, household members, alcohol use

29

Study Protocols

Methods

- Data handling and procedures
  - *PDA, tablet, paper forms*
  - *Data entry and cleaning*
  - *Software used (Epi-Info, Excel, MS Access, etc.)*
  - *Data storage (password-protected computer?)*

30

Study Protocols

Methods

- Laboratory procedures
  - *Sample type, tests performed, location of testing*
  - *Quality control*
- Data analysis plan
  - *Descriptive analysis (provide dummy tables)*
  - *Procedures for coding your variables – e.g. we will create a summary score of physical activity based on responses to five questions*
  - *Procedures to handle missing data and outliers*
  - *Statistical methods to test your hypothesis*

31

Study Protocols

Methods

- Training & project management
  - *Who will run the study to ensure the work is done well*
  - *Training in standard operating procedures*
  - *Supervision and quality control*
- Limitations
  - *State the main design limitations and how you will address them*
  - *Sources of biases, weaknesses of study design*

What is a limitation of your study if you only sample public school children? How could you justify this?

32

Study Protocols

Ethical Considerations

- Describe informed consent process (if human subjects involved)
- Methods to ensure confidentiality
  - Use of identifying information
  - Data storage and protection
- Safety and protection of study participants

33

Study Protocols

Timeline

- Provides overview of timing of the different phases of the study:
  - Ethical approval
  - Subject recruitment and enrollment
  - Data collection
  - Data analysis
  - Presentation of results

34

Study Protocols

Example Timeline

Activity	Year 1				Year 2				Year 3			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
Ethical approval	X	X										
Recruitment and enrollment			X	X								
Data collection and follow up					X	X	X	X	X	X	X	
Laboratory analyses						X	X	X	X	X	X	X
Data analysis and publication											X	X

35

Study Protocols

Resources

- Resources available
  - Personnel
  - Facilities
  - Materials
- Budget and justification
  - You would develop this section with a budget manager
- You need to show that you have the human and financial resources to conduct this study

36

Study Protocols

References

- Include in standard reference format
- Refer to ICJME guidelines: https://www.nlm.nih.gov/bsd/uniform_requirements.html
- Do **NOT** cite publications from organizations (such as WHO,CDC, etc.) or without a first author listed as 'Anonymous'!
  - See ICJME guidelines for proper citation

37

Study Protocols

Appendices

- Include:
  - Questionnaires or other data collection instruments
  - List of variables with definitions
  - Dummy tables
  - Participant recruitment materials
  - Informed consent documents
  - Local approval letters, e.g. RMOs

38

Study Protocols

Common Problems With Study Protocols

FETP Field Epidemiology Training Program

39

Study Protocols

Potential Problems

- Research objectives are not specific
- Study objectives too ambitious, not feasible, poorly justified
- Insufficient details on study procedures
- Inappropriate analysis methods
- Inadequate resources available for completing the research objectives

40

Study Protocols

Non-Specific Research Objectives

Example:

"To gain a better understanding of the trends in influenza mortality in Country X."

How to correct?

"To use sentinel surveillance data to compare weekly influenza mortality rates for the years 2000 through 2015 in Country X."

41

Study Protocols

Study Objectives Too Ambitious, Not Feasible

Example:

"To determine the prevalence of HIV infection among all residents of County A, Liberia."

How to correct?

"To estimate the prevalence of HIV infection among residents of County A, Liberia using cluster sampling methods."

42

Study Protocols

Poor Justification

Example:

"This study is needed because previous studies on this topic were inadequate."

How to correct?

"This study is needed because previous studies on this topic: (1) Did not use probability-based sampling methods, which limits the generalizability of their results, and (2) used non-validated methods to determine exposure, which may have resulted in misclassification of subjects."

43

Study Protocols

Insufficient Details about Study Procedures

Example:

"Healthy control subjects will be recruited from local health clinics."

How to correct:

"Control subjects will be recruited from health clinics X and Y. Persons aged 12 to 18 years who present for routine check-ups and who have no major complaint or illness will be eligible for the study."

44

Study Protocols

Inappropriate Analysis Methods

Example:

"Risk ratios will be calculated for all risk factors to compare the probability of being a case or a control for each factor."

How to correct?

"Odds ratios will be calculated for all risk factors to compare the odds of being a case or a control for each factor."

45

Study Protocols

Unrealistic Timeline

Example:

"We will recruit and enroll 50 dengue hemorrhagic fever (DHF) patients per week to reach our goal of 200 subjects in one month."

How to correct?

"Based on a average weekly incidence of 15 cases per week, we will recruit and enroll 10 dengue hemorrhagic fever (DHF) patients per week to reach our goal of 400 subjects in 20 weeks (5 months)."

46

Study Protocols

Inadequate Resources

Example:

"Face-to-face interviews will be conducted and blood samples will be drawn from all 200 subjects. A nurse will be hired to conduct this task."

How to correct?

"Four teams each consisting of a nurse and an interviewer will be sent out in the field to conduct interviews and collect blood samples from 50 subjects each."

47 Study Protocols

Group Protocol For The Course

48 Study Protocols

Study Protocol for FETP Trainees

- In this course, we will follow one protocol
- The topic is _____
- You will develop your own analysis plan
- You will collect and analyze data specific to your field site, and submit a final report
- You and your colleagues will combine your results at the end of the course

49 Study Protocols

Stay Tuned!

- More discussion on course study protocol later in this Module

50 Study Protocols

Summary

- A comprehensive and well written study protocol is an invaluable tool to investigators before and during the study
- It should describe how you expect the study to proceed, including a clear and precise research plan
- Content must be sufficiently detailed so that any individual could perform the study

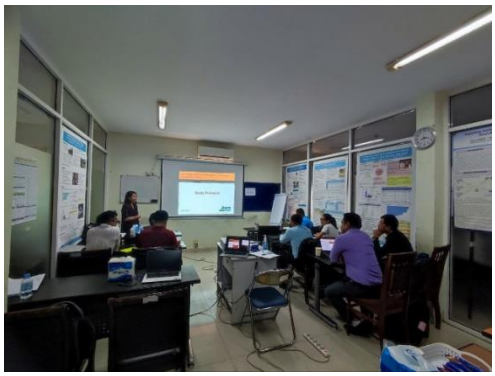
51 Study Protocols

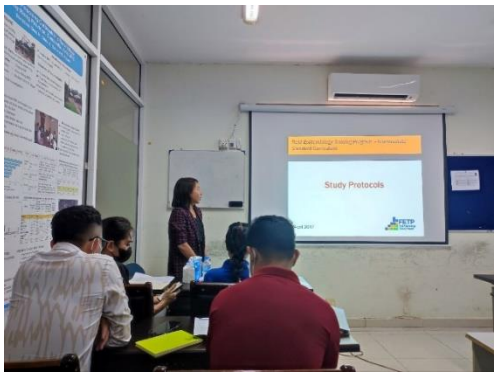
References

- CDC. Developing a protocol. *www.**cdc**.gov/niosh/nas/mining/pdfs/**Protocol**%20**Checklist**.pdf*

52 Study Protocols

Appendix 6.2: Pictures of the teaching





Appendix 6.3: Teaching slides: Lessons from the Field

Conducting a Knowledge, Attitudes, and Practices (KAP) Survey in Live Bird Markets, Cambodia

By Malen CHAN

Lesson learned From the Field (LFF)

Session of July 2023

Acknowledgements: Dr. Samantha Colquhoun
Dr. Sowath LY
Dr. Claude FLAMAND
Dr. Erik KARLSSON

1

Contents

I. Idea

II. Objectives

III. The fieldwork procedures

2

I. Idea …

- To provide MAE students information on processes towards a fieldwork in a specific setting in figuring out the process and related processes in Cambodia.

- The information given is based on my fieldwork experience in Live Bird Markets in Cambodia

3

II. Objectives

At the completion of this LFF, the learning members will be familiar with:

- The processes of fieldwork related to Live Bird Markets in Cambodia
- The logistics and permission required for this fieldwork
- Identify challenges and draw lessons from this specific context of Cambodia

4

III. The fieldwork procedures

1. Preparing the study protocol
2. Submit request letters to relevant city or provincial halls
3. Inform the directors of the markets or local authority at the live bird markets
4. Prepare the logistics for the fieldwork
5. Prepare the training
6. Budget
7. Conduct the survey and challenges

5

1. Preparing the study protocol

➡ Submit to the National Ethics Committee for Health Research in Cambodia (NECHR)

- Application form
- Cover letter
- Summary of study protocol
- Supporting letter from Disease Control and Prevention (CDC)
- Full project description
- Information sheet and Consent form
- Questionnaire
- CVs (A Cambodian or/and foreigner)
- Budget estimation…

Photocopy : 20 copies
Cost: 400 USD (free for students)


Institut Pasteur du Cambodge
Le Directeur

Phnom Penh, October 13, 2022

His Excellency
Professor ENG Huot
Secretary of State, Ministry of Health
Chairman of the Cambodian National Ethics Committee (NECHR)

Subject: Submission to NECHR for approval of research protocol entitled "Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID pandemic among live poultry market workers".

APPLICATION FORM FOR SUBMIT TO ETHICS COMMITTEE

Submitting institution/organization: INSTITUT PASTEUR DU CAMBODGE
Address: 5 Monivong Blvd, PO Box 983
City: Phnom Penh
Country: Cambodia

Protocol Title: Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID pandemic among live poultry market workers, 2022-2023

Version N°: 1 Dated: 13 October 2022

STUDY TYPE ☒ (only one choice)

☒ Cross Sectional study. ☐ Case-control st

☐ Quasi experiment. ☐ Community tri

☐ Other:

RESEARCH TOPIC ☒ (multi choices)

សង្ខេបពីគំនាវ នៃការសិក្សា

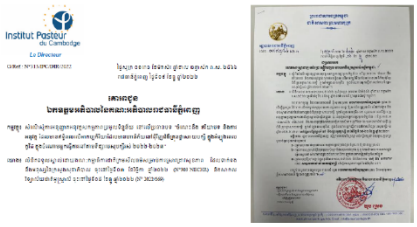
SUMMARY OF STUDY PROTOCOL

	ជាភាសាខ្មែរ/English
ចំណងជើង Title	Knowledge, attitudes, and practices influencing risk behaviours around avian influenza during the COVID pandemic among live poultry market workers 2022-2023

2. Submit request letters to relevant city or provincial halls

- Letter: date for fieldwork and who?
- Wait for a response
- Attachment: Approval letter and summary protocol etc.

- **Communicate with the administrator or a focal point**
- **Instead of telegrams, local authorities will communicate directly with other authorities.**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Le Directeur

7

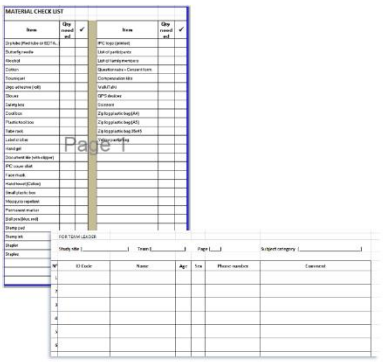
3. Inform the directors of the markets or local authority at the live bird markets



8

4. Prepare the logistics for the fieldwork

- Schedule and teamwork
- Transportation
- Accommodation
- Checklist : Mask, cleaning gel and Incentive for respondents....
- Contact list: all respondents are recorded/ for phone interview (request consent form in the field)



9

5. Prepare the training

- Information sheet and inform consent, Questionnaire and overview of the market
- Behaviour
- Pilot test of the questionnaire

10

6. Budget

Apply for IPC (Some organizations will be different rate):

- Perdiem- Province:
  - overnight stay = 48 USD
  - half day = 12 USD if arrived in IPC after 1:01pm
  - half day = 18 USD if arrived in IPC after 6:00pm
  - Vet officer/ local guide = 20 USD/day (depend on location: 15$)
- Perdiem- Phnom Penh:
  - Nurse and supervisor outside= 20$ per day (working hour from 4am=25$)
- Van Rental:
  - Phnom Penh=50$ per day
  - Takeo=75$ per day
- Water: Provided by IPC
- Incentive: Lux (0.5$)/ phone interview: 1$ (Phone card)

11

7. Conduct the survey and challenges

- Poultry workers are busy
  - Some markets: Sell only in the morning
- Place for interview
  - At the selling place
- Flexible and be patient
  - Follow's respondents

12

7. Conduct the survey and challenges (Cont.)

- Poultry workers are busy
  - Some markets: Sell only in the morning

13

7. Conduct the survey and challenges (Cont.)

- Place for interview:

Before

Now

14

7. Conduct the survey and challenges (Cont.)

- Flexible and patient

15

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Thank you for your attention!
Q & A

16