

## RESEARCH ARTICLE

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# Investigation of Social Innovations for Handling *Opisthorchis viverrini* and Cholangiocarcinoma in Thailand's Highest-Risk Areas for Further Development of Successful Solution

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### Abstract

**Background:** Despite the national campaigns in 1997 to control *Opisthorchis viverrini* (OV), a significant risk factor for cholangiocarcinoma (CCA) was accounted for in the northeast of Thailand, which is also considered the highest-risk area for CCA as per the latest national-wide survey in 2019. Social innovations were employed to address OV and CCA issues in this area, but they have yet to be thoroughly investigated. Investigating social innovations in areas where issues can already be solved is a particular approach for expanding on a broad basis. **Objective:** This study aimed to search for social innovations used to handle OV and CCA in northeast of Thailand. **Methods:** Researchers coordinated with the Office of Disease Prevention and Control Region-10 (1 of 12 regional offices under the Department of Disease Control, Ministry of Public Health) to specify the model areas for taking OV and CCA. In addition, researchers cooperated with local coordination units for data collection. The data were coded and classified for content analysis, and triangulation was performed for comparative analysis. Finally, a meeting was conducted to summarize the social innovations discovered in each study site area. **Results:** Our findings have been presented according to the epidemiologic triad: agent (risk factors), host (individuals/communities), and environment. The researchers and experts addressed and proposed social innovations for dealing with OV and CCA, such as the "3 Health" (Health Behaviours, Health Hygiene, and Environmental Health), in order to achieve a CCA-free society. **Conclusions:** This is the first study to highlight the significance of social innovations in managing OV and CCA. The findings will be utilized to further create strategies for addressing these public health issues in this and other regions in a sustainable and successful manner.

**Keywords:** Public Health- social innovations- epidemiologic triad- *Opisthorchis viverrini*- cholangiocarcinoma

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### Introduction

The Department of Disease Control, Ministry of Public Health has performed disease prevention and control work throughout Thailand under the Twenty-Year National Strategic Plan for Public Health (2017-2036) [1], especially in the northeastern region, which was once the area with the highest incidence of cholangiocarcinoma (CCA) in the world [2]. In Thailand, health zones have been established as the primary mechanism for driving participatory health system reform consistent with the health needs of people, families, and communities. At present, there are 12 health zones and Bangkok (or 12+1 zones) in line with the framework of the leading partners' work areas, namely the Ministry of Public Health, National Health Security Office (NHSO), and National Health Commission Office (NHCO) [3]. Although there have been efforts to organize campaigns at the national

level to control the leading risk factor for CCA, such as *Opisthorchis viverrini* (OV) infection, since 1997 [4], the latest nationwide survey in 2019 from 12 Regional Health Offices of Thailand revealed that the prevalence of OV was 2.2% throughout the country. The highest was found in the northeastern region, i.e. 4.97% [5]. Compared to the survey conducted a decade ago, in 2009, it was still the northeastern region with the highest record of 21.32% [6]. The prevalence rate has considerably decreased. The Regional Health-10, consisting of 5 provinces: Ubon Ratchathani, Sisaket, Yasothon, Mukdahan, and Amnat Charoen, had an average prevalence of 28.7% [6]. That was the highest average prevalence compared to other regional health areas. Therefore, Regional Health-10 is the area with the highest-risk in Thailand. The problem must be thoughtfully and urgently solved.

For the guidelines and measures to solve the problem of OV and CCA in some areas in the northeastern region

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of Thailand in the past, social innovations were used, and empirical results were recognized. Social innovation refers to new activities, products, or services primarily meeting society's needs. It is developed and disseminated through social organizations that help build society, communities, and the environment to be efficient and effective in improving people's quality of life [7]. However, the operations in those areas have not been systematically studied or synthesized. But it is not an operational issue at all. Bill Clinton said, "Almost every problem is handled by someone in some place. The challenge in the 21st century is that if management is found to be effective, it should be expanded" [7]. Searching for social innovations in the areas where problems can already be solved for further development is one of the best approaches to expanding and disseminating innovations on a wide scale. Therefore, social innovations are essential for national development, and they can be measures of the strength of the community in dealing with problems by the community itself. Although social innovation is significant in solving spatial problems, it has yet to be applied in OV and CCA dealing. Thus, this research aimed to explore social innovations used to handle OV and CCA in 5 provinces in Regional Health-10, northeast of Thailand. The results will be used for further development in the next phase to solve these critical public health problems sustainably and successfully in this area or another region.

## Materials and Methods

### *Study design, study areas, and determination of study area*

This study aimed to explore for social innovations used to handle OV and CCA in Regional Health-10, the highest-risk area in Thailand. The study areas include five provinces in Regional Health-10 (red zone in Figure 1): Ubon Ratchathani, Sisaket, Yasothon, Mukdahan, and Amnat Charoen, which is known as the highest-risk area in the country. According to the report of the prevalence survey of OV in the northeastern region of Thailand in 2009, the average prevalence in this area was 28.7%, which was higher than in other parts [6].

The process of defining the study areas was as follows.

- (1) The research team coordinated with the Office of Disease Prevention and Control Region-10, Ubon Ratchathani, to request information on the model areas with empirical results in dealing with OV and CCA.
- (2) The Office of Disease Prevention and Control Region-10, Ubon Ratchathani, specified the following model areas:
  - (i) Ban Nongbo, Nongbo Subdistrict, Mueang District, Ubon Ratchathani Province,
  - (ii) Ban Kha Yung, Kha Yung Subdistrict, Uthumphon Phisai District, Sisaket Province,
  - (iii) Ban Khu Mueang, Khu Mueang Subdistrict, Maha Chana Chai District, Yasothon Province,
  - (iv) Ban Kok Daeng, Kok Daeng Subdistrict, Nikhom Kham Soi District, Mukdahan Province, and
  - (v) Ban Rai Khee, Rai Khee Subdistrict, Lue Amnat District, Amnat Charoen Province.
- (3) The research team coordinated with the local organizations to collect data. Each province has local coordination units varying according to the area context and social innovation, including the community, Subdistrict Health Promoting Hospital, Subdistrict

Administrative Organization, or District Public Health Office (Figure 2).

### *Study participants*

The model areas with empirical results in handling OV and CCA were selected. The inclusion/exclusion criteria for choosing the volunteers were as follows inclusion criteria: Five villages whose leaders consented to participate in the research project from 5 provinces. The total target group in each area was 30 people. They consisted of ten community leaders (including one village headman, one assistant village headman, one public health officer, one village health volunteer president, five village health volunteers, and one village philosopher) and the 20 representatives of the villagers willing to participate in the research projects.

### *Research tool*

The research tool was the interview form used with the key informants. In each interview, a set of main questions was used. But it was not limited only to these questions. The questions prepared by the researcher were looks like a guideline for creating questions because the words must be adjusted according to the context or situation of the interview. Finally, the critical information were obtained. The questions were as follows.

There were four main questions: (1) What are the characteristics of the development of the social innovation to handle OV and CCA in the area? (2) How has this social innovation used to handle OV and CCA changed throughout operation? (3) What are the success factors in developing the social innovation to handle OV and CCA in the area? (4) What are the obstacles in developing the social innovation to handle OV and CCA in the area?

Based on the essential points mentioned above, the following questions were also used in the interviews: (1) How many years have you lived in this village? (2) What essential changes have the village made in handling OV and CCA throughout your time here? (3) How did this project happen? (4) What did you help with this project? (5) What motivated you to participate in this project? (6) What are the five main characteristics of this project? (7) Was this project modeled after another? (8) Were any people/organizations/networks involved? (9) What are the beliefs/folk wisdom affecting the success of this project? (10) What are the beliefs/folk wisdom hindering the success of this project? (11) How has this project been developed to other projects? (12) What are the five crucial factors affecting the success of this project? (13) What are the five main obstacles to the success of this project?

### *Data collection*

The data were collected in two steps. Step 1: The preparation step consists of (1) contacting and coordinating with the community leaders to ask for cooperation in conducting the research, (2) submitting a letter requesting support for target groups, locations, and organization of activities, (3) preparing a manual and documents for research conduction, (4) preparing tools and equipment used in organizing activities, and (5) constructing the research tool and verifying the quality of

the tool. Step 2: The operation step includes (1) informing the research objectives of the target groups, (2) explaining the data collection process, (3) requesting permission from the target groups to consent to data collection by signing the consent form to participate in the research, (4) collecting data in the area, (5) checking the completeness of the questionnaire for data analysis, and (6) conducting statistical analysis.

### Statistical analysis

The data analysis was performed by (1) checking the completeness of the questionnaire, (2) creating a coding manual, (3) correctly coding the questionnaire, (4) recording data with a computer program two times, using two research assistants and ensuring that the recorded data must be the same for both times (validate) and checking whether the variables had codes other than those specified by creating a one-way frequency distribution table and checking consistency between variables by creating a two-way frequency distribution table, and (5) correcting the data before analyzing data using the Statistical Package for the Social Sciences (SPSS) version 26.0 software program. Similarly, quantitative data was analyzed using a frequency distribution table with number, percentage, mean and standard deviation, and minimum-maximum value. For the data that were not normally distributed, the median and minimum-maximum values were presented to describe the mean value of the data. Moreover, qualitative data were coded and classified for content analysis, and triangulation was performed for comparative analysis.

## Results

After the research team visited the areas to search for social innovations used to deal with OV and CCA in Regional Health-10, a meeting was held to analyze and summarize the social innovations discovered in each area. The social innovations were presented according to the epidemiologic triad, including agent (risk factors), host (individuals or communities), and environment, as shown in Table 1.

After that, the research team invited the experts in preventive medicine and public health to attend a meeting to discuss and provide suggestions on the social innovations used to handle OV and CCA. Finally, the social innovation “3 Health for a Society Free from CCA” was obtained. It includes the following 3 Health: (1) Health Behaviors, (2) Health Hygiene, and (3) Environmental Health (Figure 3). It consists of the following details.

**Health Behaviors:** A breaker prevents the agent from entering the host (individuals or community). It is a crucial issue used to create a manual for avoiding and controlling OV and CCA. The content includes the following topics: (1) stop consuming raw or undercooked freshwater fish in the family Cyprinidae; (2) do not drink alcoholic beverages; (3) regularly undergo parasite tests; (4) examine the abdominal cavity using ultrasound to look for abnormalities in the bile ducts, (5) change behavior without taking or taking too much praziquantel and (6) consume clean, fresh vegetables and fruits in appropriate quantities regularly. These protective factors against OV were gained from the systematic review and meta-analysis.

**Health Hygiene:** A breaker prevents the host (individuals or community) from releasing waste or unwanted things into the environment. This is another vital issue for creating a manual for avoiding and controlling OV and CCA. The content consists of the following topics: (1) organize campaigns for people to use toilets 100% both at home and outdoor workplaces such as gardens, farms, and fields; (2) support the construction of a sewage treatment pond to treat sewage before releasing it into water sources or the environment by the local administrative organization; and (3) regularly check pets' health, including dogs and cats, and do not feed them raw or undercooked freshwater fish in the Cyprinidae family.

**Environmental Health:** It is a breaker preventing the environment from influencing or supporting the agent to have more ability to spread disease. This is a crucial issue for creating a manual for avoiding and controlling OV and CCA. The content consists of the following topics: (1) biological environments, such as eliminating *Bithynia* sp., which is the 1st intermediate host of the liver fluke

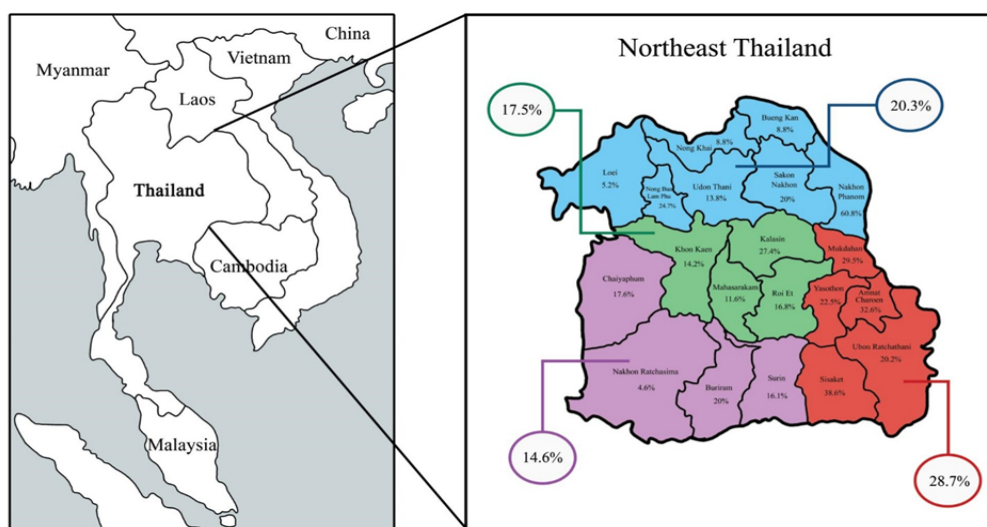


Figure 1. Study areas

Table 1. Social Innovations Used to Handle OV and CCA in the Highest-Risk Area of Thailand.

Study area	Social innovations used to handle OV and CCA	
	Agent (Risk factors)	Host (Individuals / Communities)
Ubon Ratchathani		Environment
Sisaket	<ul style="list-style-type: none"> <li>• NONGBO NO-CCA Model</li> <li>&gt; Active involvement in preventing CCA, establishing networks to support community healthcare, enhancing community self-reliance, and encouraging chemical-free fruit and vegetable cultivation</li> <li>• 4 Ps, and IE</li> <li>&gt; P1: Promoting behavior modification by not consuming raw or undercooked freshwater fish</li> <li>&gt; P2: Providing knowledge of clean cooking and papaya salad free of raw fermented fish</li> <li>&gt; P3: Persuading stool examination and abdominal ultrasound</li> <li>&gt; P4: Practicing based on the advice of the multidisciplinary team and monitoring and providing care for at-risk groups</li> <li>&gt; E1: Excreting feces into the toilet and disposing of waste properly</li> </ul>	<ul style="list-style-type: none"> <li>• Preventing OV and CCA by Youth Village Health Volunteers</li> <li>• Winner of the model village for OV prevention</li> <li>• Referral for treatment/surgery/palliative care by a multidisciplinary network at the district level</li> <li>• Communicating to the public by risk communication to change the behavior of the at-risk groups</li> </ul>
Yasothon	<ul style="list-style-type: none"> <li>• No alcoholic beverages in merit-making events</li> </ul>	<ul style="list-style-type: none"> <li>• Support the Subdistrict Administrative Organization in constructing a sand filter pond for sewage treatment to control the spread of parasitic eggs into water sources considered environmental management with community participation</li> </ul>
Mukdahan	<ul style="list-style-type: none"> <li>• Screening for OV in people aged 15 years and over</li> <li>• Screening for CCA by ultrasound in people aged 40 years and over or those having OV eggs detected</li> </ul>	<ul style="list-style-type: none"> <li>• A sewage treatment pond managed by the local administrative organization to treat sewage to be free of parasitic eggs and environmentally friendly before releasing it into water sources</li> </ul>
Amnat Charoen	<ul style="list-style-type: none"> <li>• Processing freshwater fish into food safe and free from OV</li> </ul>	

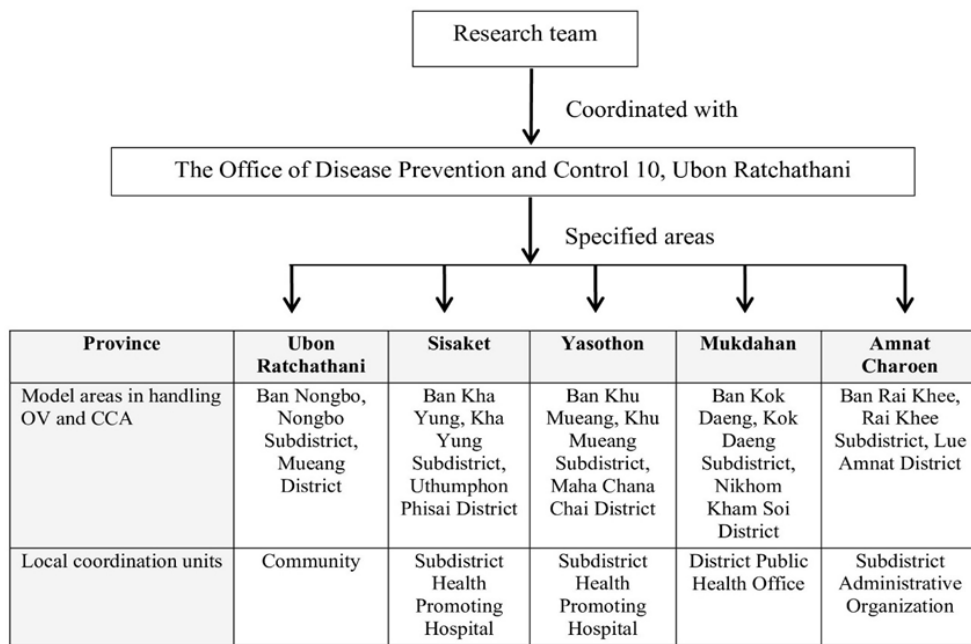


Figure 2. Determination of the study Areas.

that can transmit the larval stage of the parasite to the 2nd intermediate host, that is, freshwater fish in the family Cyprinidae, including carp, Jullien’s mud carp, swamp barb, minnow, hard-lipped barb and (2) social/cultural environment, such as requiring the abstaining from drinking all types of alcoholic beverages at religious or traditional ceremonies to reduce the spread of the main risk factors for CCA. Community measures or participation may be used in issuing rules or regulations.

## Discussion

In our settings, the social innovations discovered in each area were summarized according to the epidemiologic triad, namely agent, host, and environment [8, 9]. The research team met with experts in preventive medicine

and public health to conclude the social innovations in each area to develop the social innovation for dealing with OV and CCA. Finally, the social innovation “3 Health for a Society Free from CCA” was obtained. It consists of 3 Health as follows.

The first Health is from “Health Behaviors,” a breaker that does not allow the agent to enter the host. The activities include campaigning for people to stop consuming raw or undercooked freshwater fish and encouraging people to undergo stool examination for liver fluke eggs. Many studies have attempted to organize these activities at the community level [10, 11], national level [4] or international level [12]. Campaign to encourage people to reduce, refrain from, and quit drinking alcohol, another leading risk factor, has also been done [13]. Abdominal ultrasound examination project to check abnormalities

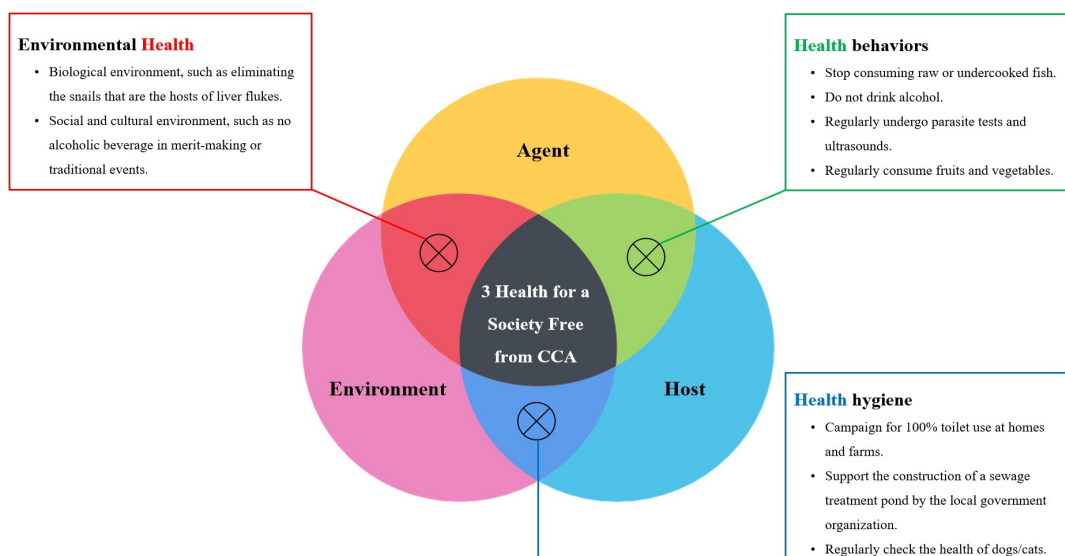


Figure 3. The social innovation "3 Health for a Society Free from CCA."

in the bile duct and campaign against excessive use of praziquantel [14] as well as encouraging people to consume fresh, clean fruits and vegetables in appropriate quantities regularly have been operated [15].

The second Health is from “Health Hygiene,” a breaker that prevents the host from releasing waste or unwanted things into the environment to break the life cycle of liver flukes. The activities include campaigning for people to use toilets everywhere, whether at home or work and recommending local government organizations provide sewage treatment ponds to treat sewage before releasing it into water sources or the environment [16]. In addition, pet owners should regularly check the health of their pets and not feed raw or undercooked freshwater fish to dogs and cats [17, 18].

The last Health is from “Environmental Health,” a breaker that prevents the environment from supporting the agent to spread more. The approaches include biological and environmental management, such as eliminating *Bithynia* sp., which is the 1st intermediate host of the liver fluke that can transmit the larval stage of the parasite to freshwater fish in the family Cyprinidae (the 2nd intermediate host) [19]. In addition, management of the social/cultural environment has also been performed, such as designating merit-making events to be alcohol-free by using community measures or participation in enacting rules to reduce risk factors for CCA [20, 21].

In conclusion, this is the first study in the world that examines at social innovations in OV and CCA management, particularly in Thailand, which has the highest risk. Searching for social innovations in areas where problems can already be addressed for further development is critical in expanding and disseminating innovations widely. It can also be used to measure the strength of the community in dealing with problems by the community itself. This is the most sustainable and successful approach to public health issues.

## Author Contribution Statement

NS, OS, and CT conceived and designed the research. NS, CT, and GS were responsible for connecting and coordinating the fieldwork. NS, OS, CT, and RJ collected the data. NS and CT carried out the analyses. NS reviewed drafts of the paper. All authors contributed to the writing and revisions of the manuscript and approved the final version.

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### Ethical approval

This research was approved by the Ubon Ratchathani Rajabhat University Ethics Committee for Human Research (HE652005). Ethical considerations were based on respect for person, risk and benefit, and justice. The chances that may arise during research and the prevention methods were always disclosed to the volunteers. The research objectives were informed to the volunteers at every step. When the volunteers decided to join the project, they were asked to sign a consent form. If they could not participate in the study, their decision was respected.

### Availability of data (if apply to your research)

Data will be available upon request.

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### Conflict of interest

The authors declare no competing interests.

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