Original Article

Anti-epidemic campaigns in Macao during the war and post-war reconstruction period (1937 - 1949): A procedural grounded theory analysis of news reports from Overseas Chinese News

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Abstract

This study explores how Macao, a semi-autonomous colonial territory under Portuguese neutrality, governed epidemic crises between 1937 and 1949 through a civic-driven, multi-actor approach. It examines how local responses to epidemics were formulated and sustained amid institutional fragility, political isolation, mass refugee inflows, and in the absence of strong centralized authority. Drawing on 1036 contemporaneous reports from *Overseas Chinese News*, the study employs procedural grounded theory to inductively reconstruct Macao's epidemic governance logic. The findings reveal six interrelated strategies: real-time epidemiological monitoring and disclosure, universal compulsory vaccination, cross-institutional and transregional collaboration, grassroots hygiene education, institutionalized civil society participation, and strict quarantine and sanitation enforcement. The study proposes a "Civic-Driven Epidemic Governance Framework under Neutrality", illustrating how decentralized collaboration, institutional improvisation, and social capital compensated for limited state control. The Macao case offers a historically grounded alternative to state-centric public health models by underscoring the role of civic engagement and cross-border cooperation
Finally, it highlights the media's dual role as a platform for public communication and a driver of social mobilization. These findings contribute to broader debates on resilient, inclusive and adaptive governance in politically fragmented or fragile contexts

Keywords: *Communicable disease control; Public health administration; Armed conflicts; Grounded theory; Macao; History of medicine.*

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Introduction

The intersection of warfare and epidemic disease has profoundly shaped human history. Armed conflicts frequently catalyze infectious outbreaks by triggering mass displacement, infrastructure collapse, and unsanitary living conditions. From the deadly typhus outbreaks during the Napoleonic Wars to the catastrophic spread of the 1918 influenza pandemic amid World War I, such crises highlight the acute vulnerability of public health systems under wartime duress. Public health responses have evolved across conflicts – from Florence Nightingale's pioneering sanitary reforms in the Crimean War to the systematic vector management efforts of the U.S. Malaria Control in War Areas initiative during World War II (1, 2). These transformations reveal how both military and civilian institutions have continually adapted mechanisms of health governance to address shifting epidemic threats.

While the narratives of epidemic management in major nation-states or active war zones have been extensively documented, far less scholarly attention has been given to how small, neutral colonial enclaves coped with concurrent crises of war, displacement, and public health degradation. Macao, a Portuguese-administered enclave in the Pearl River Delta, represents a historically understudied yet richly instructive case. Despite Portugal's declared neutrality during World War II, Macao became a sanctuary for hundreds of thousands of refugees fleeing the Japanese invasion of China. The colony's population soared from roughly 150,000 pre-war to over 500,000 at its peak, placing immense pressure on its housing, sanitation, and limited medical infrastructure (3). This extreme overcrowding and infrastructural deficit heightened the risk of major infectious disease outbreaks.

Despite its institutional fragility and limited resources, the colonial government was compelled to respond to a mounting series of public health emergencies. In response, it established an Epidemic Prevention Bureau and collaborated with local charities, Chinese medical associations, and neighboring territories – most notably Hong Kong – to implement epidemic control strategies. Consequently, the anti-epidemic campaign was not solely a biomedical effort but a multifaceted governance endeavor, shaped by geopolitical constraints, refugee influxes, and cross-sector coordination. Compared to other war-affected cities in the region, Macao's approach was distinctive for its reliance on civic mobilization and

transborder coordination in the absence of centralized governance structures.

However, existing grant review committees on wartime epidemic governance have largely overlooked cases such as Macao. The majority of studies addressing health governance during World War II focus on major powers or active combat zones (4, 5). Although recent grant review committees have begun to explore Macao's diplomatic neutrality and its role as a refugee haven (6, 7), little attention has been paid to the colony's internal public health strategies, especially from an empirical or governance-focused perspective. Furthermore, existing historical epidemic studies on China tend to rely on official archives or retrospective accounts, often neglecting contemporaneous public discourse and community-driven responses that shaped on-the-ground epidemic management.

The present study addresses these scholarly gaps by applying a procedural grounded theory analysis to 1036 epidemic-related reports published in *Overseas Chinese News*, the most comprehensive Chinese-language newspaper circulated in wartime Macao. As a source, it preserves firsthand observations, governmental proclamations, and public sentiments from 1937 to 1949, rendering it a uniquely rich archive for historical epidemiological analysis. Grounded theory – specifically in its procedural variant – offers a structured and replicable methodology for inductively deriving categories, themes, and theoretical insights from large-scale qualitative data. By applying this method to an underutilized yet information-rich corpus of wartime journalism, the study not only reconstructs Macao's epidemic practices but also formulates a broader analytical framework for understanding collaborative governance under systemic duress.

This study contributes to wartime epidemic governance literature by expanding its geographic focus, applying grounded theory to historical health data, and emphasizing governance in low-capacity contexts. Its insights are relevant not only to scholars but also to policymakers seeking resilient, adaptable models in politically fragmented or fragile settings.

Methods

Data Sources

Founded in Macao on November 20, 1937 (the 26th anniversary of the establishment of the Republic of China), and the first newspaper in Macao to utilize the telegraph, *Overseas Chinese News* is the only Chinese language newspaper in Macao that has been publicly circulated and preserved in its most

complete form since the war era. With the motto "Based in Macao, reporting objectively, and serving the community", it succeeded in maintaining a relatively neutral and consistent editorial stance, even during the turbulence of war. The original Portuguese name *Jornal Va Kio* was used at the time of its founding, but for consistency and clarity, this study refers to the newspaper uniformly as *Overseas Chinese News.*

During the war, the newspaper continued to provide comprehensive reporting on Macao's conditions across various sectors and societal levels. The selection of this newspaper as the primary source for studying Macao's anti-epidemic campaign during this period is representative to a certain extent.

In this study, 1036 reports on epidemic prevention were screened out from the historical database of *Overseas Chinese News* from 1937 to 1949 to establish a research sample pool. The average annual number of reports in the sample pool of this study was 80, but showed a fluctuating upward trend, reaching a peak of 175 in 1949 (Figure 1). Word frequency analysis of the reported texts revealed that "injection", "hygiene", "citizen", "epidemic prevention", "authority", "cholera", "work", "health bureau", "test", and "doctor" appeared more frequently in the scanned database (Figure 2).

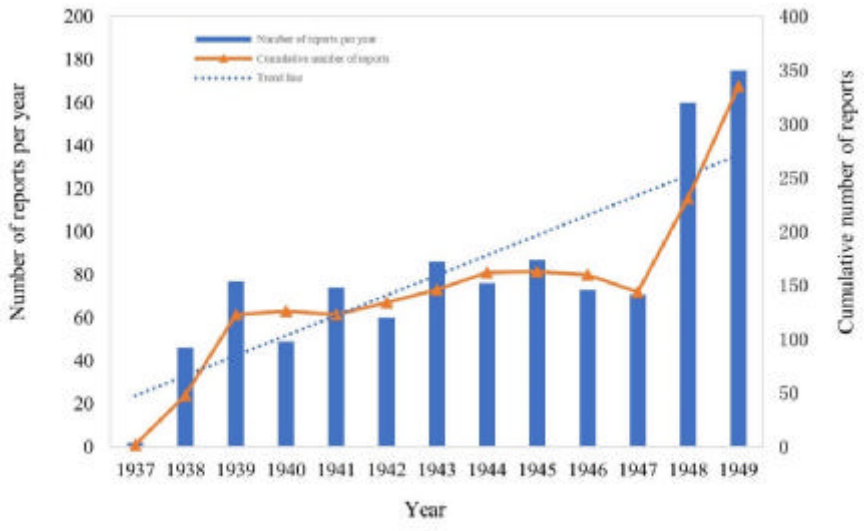

Figure 1. Number of reports related to the anti-epidemic campaign in *Overseas Chinese News*, 1937 - 1949

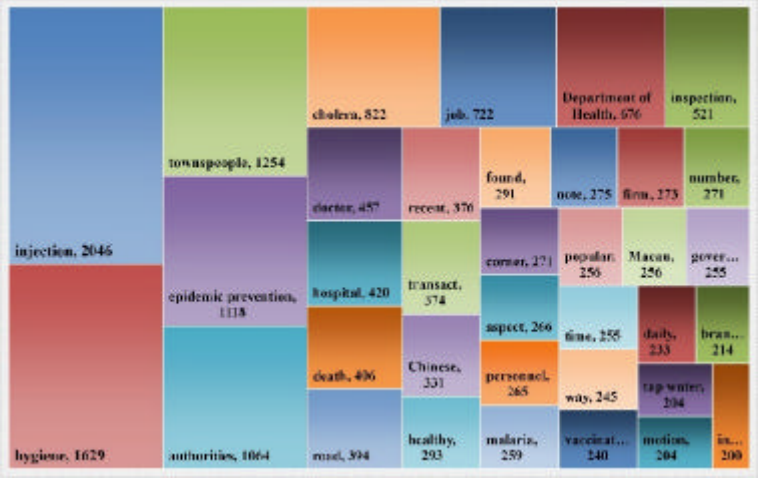

Figure 2. Frequency of words in the text of reports related to the anti-epidemic campaign in *Overseas Chinese News*, 1937 - 1949（n ≥ 200）

Research Methods

Grounded theory is an important method for conducting qualitative research. It was proposed by Glaser and Strauss in 1967 (8) and primarily involves theoretical sampling, coding, and analysis of data to ultimately construct a theory (9). Currently, grounded theory is divided into three main schools: classic grounded theory, procedural grounded theory, and constructivist grounded theory. The aim of classic grounded theory is to develop a theory from field data through a systematic process of data collection and analysis, rather than from a pre-established theoretical framework (10). Procedural grounded theory builds on classic grounded theory, with more emphasis on systematic and procedural steps and technical details (11). Constructivist grounded theory, influenced by social constructivism, emphasizes the interaction and co-construction between the researcher and the research subjects (12).

This study primarily employs procedural grounded theory, using the qualitative analysis software NVivo to perform three levels of coding on the 1036 reports. First, open coding, which involves a preliminary analysis of the raw data with a completely open attitude, conceptualizing the data sentence by sentence and determining the categories of these concepts. Second, axial coding, which goes on to further summarize the concepts and categories obtained from open coding, identifying the relationships between the subcategories, and categorizing them. Third, selective coding, in which core categories are

selected after a systematic and comprehensive analysis and linked with other categories to construct a multidimensional network of relationships around all categories and subcategories, ultimately forming the research conclusions.

Results

1) Open Coding

Open coding consists of two stages: conceptualization and categorization. At the conceptualization stage, the text was segmented, refined, and coded using NVivo to generate 4560 coding reference points, forming 43 concepts without repeating meanings. The concepts were clustered and categorized in the second step of categorization to develop nine subcategories, including "epidemiological trends and characteristics of infectious diseases" (Table 1)

Table 1. Main categories, subcategories and concepts formed by open coding and axical coding

Main Category (n)	**Subcategory (n)**	**Concept (n)**	**Representative Excerpts from *Overseas Chinese News***
Epidemic Response (3852)	Report on epidemiological trends and characteristics of infectious diseases (1889)	1. Chronology report (401)	This year, cholera and other epidemic diseases have been spreading. According to investigations, there were eight cases on the 17th, three on the 18th, and three more yesterday (the 19th). (13)
		2. Cholera (822)	Cholera has recently been spreading in Macao, with several cases being reported each day. The disease spreads rapidly and is mostly caused by unsanitary food and water. The Health Bureau has issued prevention guidelines, banned the sale of contaminated frozen goods, and offered free vaccination at clinics (14).
		3. Malaria (259)	Malaria is an acute infectious disease that can be fatal within a few days in its malignant form. Treatment includes oral medication and injections for persistent cases (15).

	4. Tuberculosis (196)	The number of tuberculosis patients in Macao has significantly increased. Director Bao Na of the Medical Bureau noted that TB is highly contagious. Patients who spit in public without regard for hygiene pose a serious threat to community health (16).
	5. Smallpox (98)	According to medical sources, smallpox is relatively easier to treat in traditional Chinese medicine. Unauthorized treatment by both Chinese and Western doctors is currently prohibited. Medical professionals are planning to petition for reinstated practice rights (17).
	6. Meningitis (61)	A considerable number of meningitis and cholera cases have been observed recently. Several cases were reported yesterday, mostly among the street-dwelling poor. Ambulances transported them to hospitals. Public Health Bureau officials believe the outbreaks are related to the consumption of unsanitary food and abnormal weather conditions (18).
	7. Dysentery (31)	The epidemic statistics are as follows: two cases of dysentery, both from Coloane Island, with no reported deaths (19).
	8. Varicella (21)	According to the weekly epidemic report, there have been 22 cases of chickenpox in Macao. Although chickenpox is not as severe as smallpox, parents are advised to pay close attention to their children's diet and hygiene (20).

	Carrying out preventive vaccination (672)	9. Vaccination stations (198)	With the arrival of spring and summer, cholera shows a tendency to spread. The Public Health Bureau has set up vaccination stations on the streets. Policemen have been deployed to encourage pedestrians to receive vaccine on site (21).
		10. Free vaccination (180)	The bureau urges citizens to be vaccinated against cholera as soon as possible. Each person is to receive two free doses, one per week. The vaccine remains effective for four to five months (22).
		11. Certificate of vaccination (172)	To prevent the spread of cholera, the authorities of Hong Kong and Macao announced that all travelers between the two regions must carry a vaccination certificate issued by the local health bureau with an attached personal photograph. The certificate is only valid six days after issuance (23).
		12. Forced vaccination (66)	To prevent the spread of cholera, the Macao health authorities recently began administering vaccines to the public. Civil servants and their families, as well as domestic workers, are now required to be vaccinated (24).
		13. Group vaccination (40)	For schools and other organizations, if a specialist is invited to administer vaccines, the bureau will provide free vaccine supplies (22).
		14. Keeping order (16)	There was extreme crowding among those waiting for vaccination and certificates. Police were dispatched in large numbers to maintain order at the site (25).

	Integration of medical resources (607)	15. Recruitment of additional health staff (230)	Kiang Wu Hospital, founded by the overseas Chinese, has been operating steadily. Authorities, including the health bureau director, plan to inspect the hospital and have proposed an increase in funding, hiring more doctors, and upgrading medical equipment (26).
		16. Increased medical equipment and facilities (123)	Due to the rise in epidemic cases, the Fire Department found that the existing ambulances were insufficient. A vehicle was purchased and modified into an ambulance, which has now been completed and is ready for use (27).
		17. Campaign for the purchase of vaccines (107)	The National Committee for the Relief of Counter-Japanese Soldiers initiated a global fundraising campaign among the overseas Chinese to procure large quantities of summer vaccines and epidemic treatment drugs for the frontlines (28).
		18. Harmonization of acute infectious diseases in national hospitals (82)	To prevent epidemic outbreaks, the Macao health authorities issued a notice requiring all Chinese and Western doctors to report cases of cholera and smallpox to the Public Health Bureau. Such cases must be referred to national hospitals and unauthorized treatment will be penalized (29).
		19. Scrutinizing the practices of health personnel (41)	Chinese doctors were instructed by the health authorities to present their medical licenses at the national hospital for verification and validation in order to have them renewed for the following year. Many have already complied (30).

		20. Government allocates funds for epidemic prevention (18)	Following a cholera outbreak, the government allocated 30,000 yuan for epidemic prevention. Dr. Costa was appointed as epidemic director, and the team worked diligently. As a result, the epidemic has now largely subsided (31).
		21. Hong Kong and Macao Joint Prevention and Control (6)	The bureau dispatched Mr. Kwok King-Shing to Hong Kong to collaborate with the local medical community and coordinate measures to eradicate malaria in the two regions. The Hong Kong side sent Colonel Dr. Wells and pharmacist Ma Kui along with a 12-member team to Macao for joint inspection and coordination (32).
	Health education on epidemic prevention and control measures (451)	22. Reminders on residential hygiene and dietary health (200)	As cholera bacteria grow in wells, the bureau issued the following prevention guidelines: boil all drinking water, avoid eating raw vegetables and fruits with broken skin, ensure baked goods and street food are covered with mesh, keep homes and toilets clean, and immediately report suspected cholera cases (22).
		23. Counseling on vaccination (119)	In addition to dietary measures, the health bureau assigned Portuguese doctors to encourage citizens to get vaccinated. More than half of the population of Macao had already received free vaccination by this time (33).
		24. Dissemination of mosquito control methods (85)	Small drainage ditches and stagnant water around homes can be cleared with individual or family efforts. If economically feasible, residents are encouraged to use mosquito

			nets and screens for added protection (34).
		25. Dissemination of sterilization methods (39)	Contaminated water or objects may carry bacteria. One should disinfect them with sterilizing agents before use, followed by rinsing with boiled water to remove any chemical residue (35).
		26. Publication of vaccination schemes (8)	Free vaccination programs will begin in mid-month. Several vaccination stations will be set up across Macao. The Health Bureau has printed and will distribute epidemic prevention guidelines for public awareness (36).
	Social organization support (167)	27. Free clinics and donation of medicines from various sectors (82)	The Macao Student Relief Committee not only provided food, shelter, and education for war refugees, but also established a health team. Doctors Fang Xijia, Liu Zhenquan, and Ke Lin provided daily medical services at refugee shelters (37).
		28. Formation of socio-epidemiological organizations (63)	Governor Daisler discussed hospital affairs with Lin Bingyan and expressed hope that Chinese doctors would form a medical association to improve public health, advance medical research, and support the government epidemic prevention work (38).
		29. Construction of vaccination stations in social organizations (22)	Chamber of Commerce representative Chen Limin proposed setting up vaccination and certificate stations at the chamber building to reduce public burden and support the health bureau. The proposal was approved and took effect the same day (39).

	Isolation and quarantine (66)	30. Quarantine (46)	As the cholera situation improved, Dr. Costa of the Health Bureau tested local seawater and found it free of harmful bacteria. The swimming ban was therefore lifted (40).
		31. Isolation treatment (20)	As cholera spread in the spring and summer, the isolation ward at the national hospital reached full capacity, forcing authorities to even utilize corridors for patient care and hospitalization. Deceased patients were quickly examined by doctors and placed in coffins by funeral workers (41).
Environmental Health Governance (708)	Conducting health inspections (391)	32. Inspection of store hygiene (163)	To protect public health, the authorities instructed the Fire Department to inspect all households for sanitation. Staff began inspections along the Lower Ring coastal area (42).
		33. Inspection of domestic water hygiene (107)	During the previous year's cholera outbreak, authorities identified water boats as a source of infection and banned their entry. Wells were also found to be contaminated and were disinfected, while the water company increased safe water supply, ultimately halting the epidemic (43).
		34. Inspection of food hygiene (56)	Xian Kee, a local bakery and drinks shop, passed hygiene inspections by the Health Bureau and was approved to sell ice cream to meet public demand (44).
		35 Inspection of street hygiene (47)	Authorities tightened rules on littering, with police patrolling streets to catch violators. Sanitation workers, supervised by the municipal office, began cleaning the streets early each morning (45).

		36. Inspection of livestock hygiene (18)	Recently, the local pork supply has been insufficient. After some discussion, the city council agreed to allow pork imports from external military sources, but only if the meat passed hygiene inspection before sale (46).
	Launching of a clean-up campaign (175)	37. Disinfection and sterilization (109)	Authorities found that cholera often spread from unsanitary food and dirty alleys. In response, they banned the sale of tainted frozen products and deployed fire trucks to spray disinfectants in alleys, assisted by the Fire Department staff (47).
		38. Road cleaning (66)	Due to a cholera surge and stagnant water near the New Port, the Fire Department dispatched trucks to pump out water. Senior officials including the fire chief and governor supervised the site (48).
	Repair of sanitation facilities (142)	39. Repair and unblocking of ditches (57)	To improve urban sanitation, the Public Works Bureau not only repaved Liansheng Road, but also dispatched workers to clean ditches in various districts to ensure water flow and reduce mosquito breeding (49).
		40. Sealing and unsealing wells (39)	Amid a water shortage, 19 sealed wells were reopened. Later, inspections found most of them unhygienic. The authorities decided to re-seal the contaminated wells and resume regular municipal water supply (50).
		41. Construction of latrines (21)	This year, the city council allocated 10,000 yuan to build several new public toilets in Macao to improve sanitation and convenience for residents (51).

	42. Decorating the walls of the house (14)	To comply with sanitation regulations, the city council ordered all pork shops to whitewash their interior walls to prevent microbial contamination of meat. Shops were given three days to comply, or face penalties (52).
	43. Construction of kennels (11)	To prevent the occurrence of rabies, the Macao Municipal Council mandated vaccination for all local dogs at the newly constructed kennel facility. Additionally, the Council issued an order requiring all dogs to wear muzzles when taken outdoors to avoid potential attacks on pedestrians (53).

2) Axial Coding

The 9 subcategories obtained from the open coding were analyzed and integrated into 2 main categories: "epidemic response" and "environmental sanitation management" (Table 1). Each code compared the results of the nodes according to the number of reference points to form a hierarchical structure diagram, in which the area of each node corresponds proportionally to its frequency, with larger nodes representing higher reference counts (Figure 3).

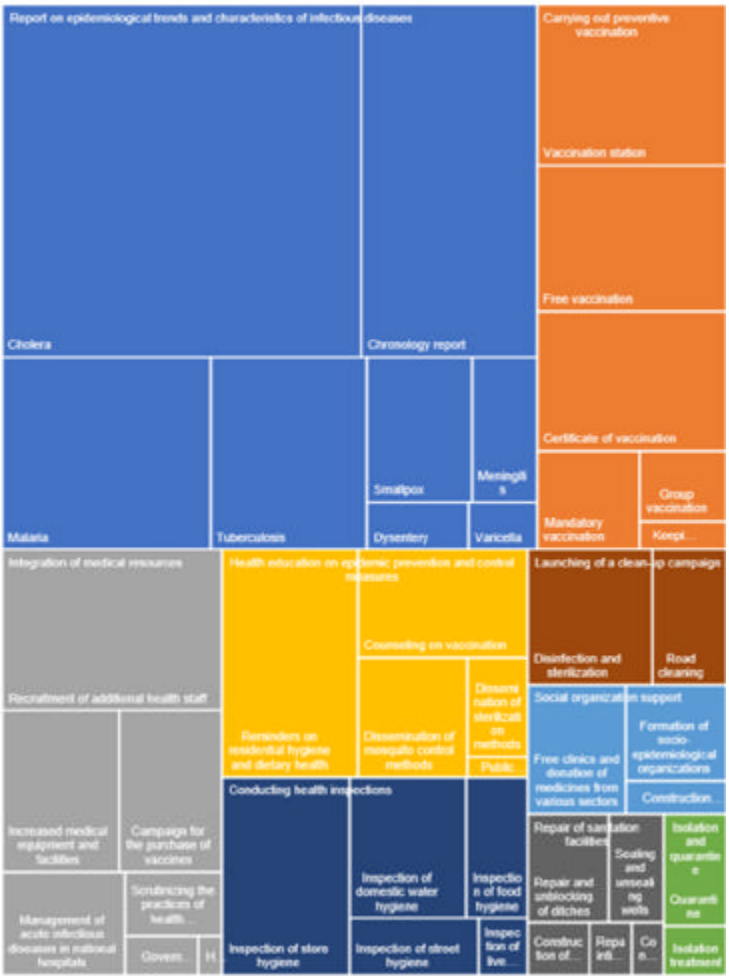

Figure 3. Hierarchical diagram of the number of codes

3) Selective Coding

The first step is to identify the core categories. The words "injection", "epidemic prevention", and "cholera" that ranked high in the word frequency of the reported text in the sample of this study were all related to "epidemic response". The total number of coded reference points for the category "epidemic response" was 3852, accounting for 84.47% of the total number of coded reference points. Accordingly, the core category was determined to be epidemic response.

The next step builds a storyline connecting all categories to the core theme. Macao's 1937 - 1949 epidemic response was a civic-led collaboration centered on disease surveillance, vaccination, resource coordination, health education, social support, and quarantine. These were reinforced by sanitation campaigns and infrastructure repair. Together, they formed the

analytical framework illustrating Macao's decentralized yet coordinated governance approach during the epidemic crisis (Figure 4).

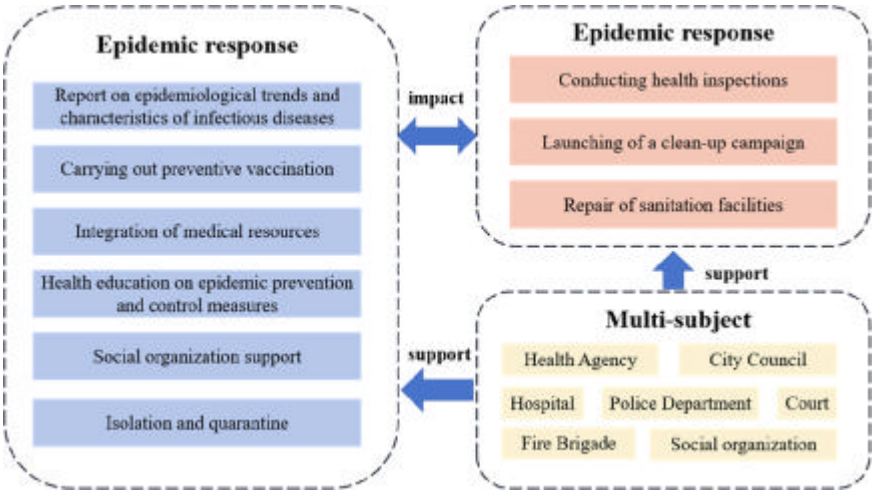

Figure 4. Analysis framework of Macao's epidemic prevention campaign in the Republic of China

Discussion

Interpretation of the response to the Macao epidemic during this period:

1) Epidemiological trends and characterization of infectious diseases

During this period, the Macao Health Bureau published a "Weekly Bulletin on Current Diseases" through *Overseas Chinese News*, which included information on the number of infected persons, sources of patients, number of deaths, etc., and reports on acute infectious diseases such as cholera, malaria, tuberculosis, smallpox, meningitis, dysentery and chicken pox. Combined with the relevant data from the Department of Health, the analysis is as follows:

- Cholera is primarily spread through contamination of pools or wells by the feces of patients or food that is exposed to flies and ants, which are the vectors of the disease. According to the statistics of the Department of Health, in 1937, 600 people were infected with cholera in Macao, and 400 people died of the disease (54).
- Malaria is most common in summer when stagnant water leads to the breeding of Anopheles mosquitoes, which transmit malaria protozoa to humans through their bite. According to the weekly bulletin of the Department of Health, there were as

many as 27 cases a week at the peak of the epidemic, with six deaths (55).

- Tuberculosis is highly contagious, and can be spread by tuberculosis patients spitting in public. According to the weekly bulletin of the Department of Health, when most rampant, there were 17 cases a week and 14 deaths (56).
- Smallpox occurs in the warm, dry fall and early winter months and can infect both men and women, young and old. In September 1946, 80 people were found to have died of smallpox, according to the Department of Health (57).
- Meningitis is often circulated or epidemic in spring and summer. The leading cause of the disease is acute suppurative inflammation caused by diphtheria invading the soft meninges and the soft membranes of the spinal cord. The bacteria are primarily stored in the mucus of the patient's throat and nasal cavity and can be transmitted through droplets. In 1932 there was a break-out in Macao, resulting in many deaths. According to the weekly bulletin of the Department of Health in 1948, meningitis is still found occasionally, and there are fatal cases (58).
- Dysentery is most prevalent in summer and is primarily caused by consuming unclean food. According to the weekly bulletin of the Department of Health, 13 cases of the disease were detected in the peak week (59).
- Varicella incidence is influenced by weather, and although it is not as severe as smallpox, there is still a need for attention to children's diet and hygiene. According to the Department of Health weekly bulletin, the highest number of patients in Macao has been 22 cases per week (60).

From the above, it can be concluded that the epidemiology of infectious diseases in Macao during this period has been characterized by pronounced seasonality, with water and insect vectors as the primary means of transmission.

2) Implementation of universal vaccination coverage

Vaccination was coordinated by the Health Bureau, local offices, police, and courts. Designated injection sites were announced via Overseas Chinese News, and vaccines were free.

Schools and public institutions could request vaccinations directly. The Health Bureau issued certificates valid for three months. Police maintained order at crowded sites, and forging certificates led to prosecution. Civil servants were required to vaccinate to receive rations, and having a certificate was mandatory for border crossing. If public uptake lagged, authorities deployed staff for forced street vaccinations and issued fines to non-compliant individuals.

3) Regional integration of medical resources

During the epidemic prevention period, the Macao Government and relevant departments increased their local human, financial and material support, with the Health Bureau being the primary coordinator of medical resources.

To strengthen health measures, Macao authorities approved expansion of the organizational structure of the Health Bureau and employment of additional health personnel, such as doctors, nurses, pharmacists and laboratory technicians, as well as recruitment of experts from overseas for treatment of infectious diseases. On several occasions, considerable sums of money were allocated to finance epidemic prevention, purchase medicines and equipment, and effectively carry out epidemic prevention and treatment work.

Before high-incidence seasons, the Department of Health purchased adequate medication for epidemic prevention and treatment, mainly including pox vaccines, malaria, dysentery and cholera medicines, necessary oils and ointments, etc. The Department of Health assumed full responsibility for treatment of cholera cases. Citizens who experienced acute infectious diseases such as cholera and malaria were not allowed to seek medical treatment without authorization and had to report to the Department of Health to receive unified care through the National Hospital.

The Conde S. Januário Hospital (also known as the Peak Hospital) is a government facility and was the only large-scale and well-equipped public hospital in Macao at the time. It could accommodate public officers and poor patients for medical treatment, and even set up a time-critical room, an isolation room, and a tuberculosis ward for the specialized treatment of patients with infectious diseases.

To protect the public, the Department of Health cracked down on unlicensed practice and reviewed credentials before reissuing licenses to practitioners. It also defined clear scopes for Chinese and Western medicine pharmacies. The Bureau of Public Finance required that medical

and pharmacy licenses first be approved by the Health Bureau. Herbal medicine stores and private drug sellers also needed Health Bureau certification before applying for operating licenses.

In terms of inter-regional coordination, the Macao Department of Health mainly liaised with the Department of Health of Hong Kong so they could exchange information about the occurrence of seasonal diseases in the two regions; they sent each other weekly seasonal disease statistical tables to stay informed about the seasonal conditions in both places and to carry out preventive measures. The medical professions of Hong Kong and Macao also liaised to cut off the transmission routes between Hong Kong and Macao and avoid cross-transmission.

4) Multi-channel investment in health promotion

The Macao Health Bureau published preventive measures through *Overseas Chinese News* and many detailed health education contents on epidemic prevention and control measures, which were easy to understand and constantly reminded the public to take precautions. The health promotion strategies focused on four main areas:

- *Promoting Hygiene and Healthy Living Habits:* Measures included having a clean diet, not drinking un-boiled water and raw food, using garbage cans with lids, cleaning spittoons and utensils inside the house, removing stagnant water, opening windows and doors to maintain air circulation, etc.
- Encouraging Vaccination: This was achieved by explaining the importance of vaccination and, when necessary, officials were appointed by the Health Bureau and the police station to convince the public to take vaccinations, or get vaccinated on the streets.
- Public Education on Mosquito Control: The Health Bureau issued detailed guidance on mosquito control, particularly to prevent the spread of vector-borne diseases such as malaria and dengue.
- Instruction in Disinfection and Sterilization Methods: The public were instructed to use boiled water to wash kitchen utensils, disinfectants to spray contaminated places, sulfur to smoke rooms, etc. Also, patients' families could

notify public hospitals to send people to disinfect.

5) Multifaceted collaboration of social forces

Reports showed that social organizations such as Kiang Wu Hospital, some chambers of commerce, relief societies and medical associations actively supported the anti-epidemic campaign during this period.

Kiang Wu Hospital was the most significant charitable medical institution in Macao at the time, and the Medical Grant Clinic regularly provided medication and treatment for underprivileged people. The Chamber of Commerce announced a program to collect anti-epidemic materials, which allowed the overseas Chinese from all walks of life to donate drugs by handing them over to the Chamber of Commerce. At the same time, the Chamber of Commerce set up an injection station and the Health Bureau provided the staff to perform the vaccination and issue certificates.

Other collaborative efforts included the Student Relief Committee's daily medical visits to shelters, and the Social Service Office's recruitment of expert physicians for refugee care. The Red Cross funded hospital reconstruction, while Macao doctors formed a Physicians' Association to support public health. Tuberculosis prevention was led by a dedicated association. The Executive Yuan's Relief Committee launched mobile clinics and first-aid training, while the Chinese Medical Association operated vaccination centers staffed by volunteers.

The above-mentioned efforts represent a collaborative governance model in which government authorities led the response while civil society organizations served as critical partners. The synergy between public and private entities made the rapid mobilization of medical resources, localized outreach, and broader civic engagement possible, effectively compensating for the government's limited institutional capacity during wartime.

6) Isolation and quarantine in two tight hands

The reports in *Overseas Chinese News* reveal that during this period, Macao implemented strict isolation and quarantine measures in the event of epidemics. Also, the Health Bureau sent officers to quarantine visitors from infected areas. Ships arriving in Hong Kong every day were required to sail into the designated no-sea zone, where doctors boarded the vessel to ensure they were free from infectious diseases before they could flow into the inner harbor terminal. All incoming

passengers were required to show their vaccination certificates.

To manage local cases, the Department of Health set up a special isolation clinic to admit patients with infectious diseases for isolation treatment. Patients with contagious diseases were required to notify the Department of Health so an ambulance could be dispatched to pick them up and drop them off at the clinic.

To support low-income residents, the government introduced a card system for underprivileged citizens, administered through local police stations. Holders of this card were exempted from all medical and transportation expenses to ensure equitable access to essential health services during public health emergencies.

Interpretation of Macao's environmental sanitation governance during this period:

1) Conducting health inspections

Sanitary inspections in wartime Macao were jointly conducted by the Department of Health, City Hall, and other municipal agencies. These inspections targeted multiple domains of public hygiene, including commercial, domestic, food, street, and animal-related environments. The key areas of inspection included:

- *Commercial Hygiene Inspections:* The Health Bureau of Macao set up a Cleanliness Section, which was responsible for investigating the hygiene of stores in the city. From time to time, they would send health workers to tea houses, restaurants, food stores and eateries to check the sanitation equipment, advise managers on compliance with hygiene regulations, and prohibit these businesses from setting up toilets and piling trash in the kitchens, etc. The establishments would be penalized if they were found to be in violation of the rules.
- *Domestic Water Sanitation:* As a rule, the water company supplies water to the public after it has been examined and sterilized by a doctor, and monthly inspections of the water mains are conducted in different districts. During an epidemic, water is most likely to become a vector. To prevent the spread of epidemics, the Department of Health sent officers to test residential and restaurant well water. In case the investigations found the water to be infected, the restaurant or business would be closed.
- *Food Safety Oversight:* Distribution of ice cream and other foods required prior inspection by Health Bureau physicians. Selling raw or unclean items or using

unsafe ice was banned, and mesh covers were obligatory. Officers routinely checked food hygiene at restaurants and stalls and violations led to immediate penalties. Imported pork and beef underwent mandatory inspection, and following some cases of poor milk quality, a Milk Lab was established where a veterinarian was assigned to testing. Contaminated products were reported to the court for legal disposal.

- Street Sanitation Monitoring: The Department of Health Cleanliness Section was responsible for investigating the city's street hygiene. Dumping garbage or other unsanitary items at entranceways was expressly prohibited and violators were fined. Those who failed to comply with the regulations would be detained and brought to justice by the police patrol at each street section and at any time.
- Animal Husbandry and Veterinary Hygiene: To safeguard public health, the Macao authorities required residents to take down unsanitary animal husbandry holding facilities such as pig-raising sheds, stables, etc. The municipal government was responsible for managing pork trading affairs and setting up slaughterhouses where pigs could be examined by doctors in the laboratory and then handed over to the government abattoir to be slaughtered. Macao authorities also stipulated that dog owners must apply for a dog license, and the City Hall regularly sent inspectors to patrol the city to capture dogs that did not have one.

2) Repair of sanitation facilities

During this period the sanitation infrastructure was maintained collaboratively by the Public Works Bureau, the Health Bureau, and the City Hall. These agencies undertook the following coordinated measures to improve urban hygiene and reduce disease transmission risks:

- *Drainage and Ditch Maintenance:* The Public Works Bureau sent engineers to unclog the ditches in the streets to avoid blockages so that the water in the gutters would flow freely and the breeding of mosquitoes and insects would be minimized. The Health Bureau and the Public Works Bureau cooperated in

inspecting the ditches in each street, and if any sort of damage was found, repairs were made immediately, and mosquitoes and germs were eliminated.

- *Well Water Safety and Sealing of Contaminated Water Sources:* Unhygienic house wells were sealed off by the City Hall. As a solution for the water shortage, the City Hall asked the Health Department to send inspectors in good health to unseal wells in line with the standard water quality.
- Latrine Construction: The government provided funding for the installation of public restrooms, and the Health Bureau ordered the construction of the facilities. Businesses that did not have restrooms were ordered to build them within a specified deadline, or they would be fined or have their licenses revoked.
- Post-Epidemic Urban Clean-Up: After the epidemic, the Public Works Bureau ordered home owners to have their internal and external walls repainted as needed.
- Animal Health Infrastructure: To prevent and control rabies, the City Hall set up a kennel to administer treatments and vaccination, and shelter stray dogs.

3) Implementation of general cleaning

The main actors in implementing the clean-up campaign were the Department of Health, the Fire Department, the National Hospital, and the City Hall. The Department of Health sent sanitary trucks to remote streets and alleys to clean out stale water and sanitize city districts on a daily basis. To eliminate germs in water sources, the Department of Health started a disinfection campaign by treating wells and springs with medicinal powder. The Department of Health, in conjunction with the Fire Department, assisted in cleaning the streets by sending out sanitation trucks every day to remove litter. The City Hall also sent sanitation workers to sweep city streets and collect the garbage.

Historical Insights and Governance Implications: Toward a Model of Civic-Driven Epidemic Response

The case of wartime Macao offers more than a historical account of epidemic prevention; it presents a distinctive governance model that holds relevance for contemporary public health crises, especially in politically constrained, low-capacity, or semi-autonomous regions. Unlike centralized epidemic responses typically

documented in wartime China or Western states, Macao's approach was shaped by its colonial neutrality, limited administrative authority, and the urgent demands of a rapidly growing refugee population. In this context, epidemic governance emerged as a civic-driven, multi-actor collaborative process, involving colonial institutions, Chinese medical associations, philanthropic organizations, and cross-border partnerships with Hong Kong and mainland cities.

This decentralized but highly coordinated response model can be theorized as a "civic-driven epidemic governance framework under neutrality", characterized by three key dimensions:

- Government-led environmental and institutional control, including sanitation inspections, vaccination mandates, and public health ordinances
- Civic and social sector mobilization, evident in volunteer-run vaccination stations, free clinics, and refugee medical assistance
- Cross-border health collaboration, through knowledge exchange and coordinated drug and personnel mobilization with neighboring regions

In today's global health landscape, where many public health crises occur in fragile or contested territories such as refugee camps, occupied zones, or politically neutral enclaves, this model offers a useful governance framework. It demonstrates how institutional improvisation, social capital, and cross-jurisdictional solidarity can jointly compensate for the absence of centralized command systems. Moreover, it reaffirms the historical value of local newspapers and community media as both data sources and mobilization tools in emergency response.

By extracting these governance models through a grounded theory approach applied to contemporaneous sources, this study contributes to the growing discourse on resilient, adaptive and inclusive public health governance. Future comparative studies may extend this framework to analyze how other marginalized regions or city-states responded to pandemics in the past, thereby enriching the typology of public health crisis responses under non-traditional governance conditions.

This study presents a grounded theory analysis of Macao's wartime and post-war anti-epidemic efforts (1937 - 1949), drawing on 1036

contemporaneous news reports from *Overseas Chinese News*. Despite the constraints of colonial neutrality, limited bureaucratic capacity, and a sudden refugee-driven population surge, Macao forged a distinctive epidemic governance model characterized by civic participation, cross-sectoral coordination, and transregional medical integration.

By inductively coding historical data, the research identified six interlocking governance mechanisms that collectively formed a "civic-driven epidemic governance framework under neutrality". These mechanisms included: epidemiological surveillance, mass vaccination, resource integration, health education, civil society mobilization, and environmental sanitation. This model highlights how public health responses in fragile or semi-autonomous territories can emerge not from centralized authority, but from distributed governance, institutional improvisation, and social capital mobilization.

The Macao case reorients our understanding of epidemic governance during wartime by offering an alternative to state-centric paradigms. It illustrates how localized resilience can be built through everyday governance practices, media-mediated coordination, and the structured engagement of community actors. Thus, the study underscores the value of historical journalism as both a data archive and an active agent in epidemic communication and social regulation.

As global public health continues to encounter challenges in conflict zones, refugee settings, and politically fragmented regions, the Macao case offers a historically grounded yet forward-looking governance blueprint. Future comparative inquiries may extend this framework to other non-traditional settings – urban enclaves, colonial outposts, or stateless zones – contributing to a broader typology of non-centralized, adaptive and civic-driven epidemic governance under emergency conditions.

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Conflict of Interests

The authors declare no conflict of interests.

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