

# An Ecosocial Approach to the Epidemic of Cholera in the Marshall Islands

*Seiji Yamada and Wesley Palmer*

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## Abstract

A cholera outbreak occurred in the Marshall Islands in December 2000 to January 2001 with over 400 cases and six deaths. Within Kwajalein Atoll, cholera occurred on Ebeye Island, while it did not occur on Kwajalein Island, three miles away. We apply Krieger's ecosocial approach in order to explicate the reasons for this dichotomy. We first examine how Marshallese people came to embody cholera as a disease state. Secondly, we examine the (a) arrangements of power, property, production, and consumption in the Ebeye-Kwajalein complex, as well as (b) human biology as it has been shaped by the ecological context in order to elucidate the pathways to the embodiment of cholera. Thirdly, we examine the cumulative interplay between exposure to cholera, as well as susceptibility and resistance to the disease at the level of individuals and the island-wide level. Fourthly, we examine who is responsible for the cholera outbreak and who describes the phenomena. We conclude that the outbreak of cholera in the Marshall Islands can be considered the biologic embodiment of disparate political and economic conditions and ecological imbalance. We suggest courses of action for those interested in addressing the inequalities and working towards health.

**Keywords:** Cholera, Micronesia, Political Systems, Environment Design, Resource Allocation, Vulnerable Populations.

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From the Asia-Pacific Center for Biosecurity,  
Disaster and Conflict Research  
University of Hawai'i John A. Burns School of  
Medicine

Corresponding Author: Seiji Yamada

Email: seiji@hawaii.edu

An epidemic of cholera occurred in the Marshall Islands in December 2000 through January 2001. We will focus our attention on two islands within Kwajalein Atoll: Ebeye Island and Kwajalein Island. Thus, this is a tale of two islands, three miles and a twenty minute ferry ride apart. Ebeye Island was the epicenter of the cholera epidemic, while there were no cases at all on Kwajalein Island. This was not a matter of a differential in rates of occurrence; it was a dichotomous phenomenon. As a chapter in the global pandemic of cholera,<sup>i</sup> the numbers of people affected were relatively small. Nonetheless, as the Marshall Islands were a Trust Territory of the U.S. until recently, we in the U.S. have some measure of responsibility for what happens there.

The purpose of this analysis is to explicitly apply Nancy Krieger's ecosocial theory<sup>ii</sup> in order to better understand the underlying causes of the epidemic. While we were not in the Marshalls during the cholera outbreak, we have worked on short-term assignments there both before and afterward. What is not referenced to other sources below is drawn from personal observations and exchanges with informants, or is considered common local knowledge. Our concern is "how social influences become literally embodied into physico-anatomic characteristics that influence health and become expressed in societal disparities in health."<sup>iii</sup> We hope that the lessons learned will serve as an impetus to address the social and ecological conditions so that such health disparities can be eliminated.

## Antecedent ecosystem conditions

*Geography, population, and culture.* The Marshall Islands are made up of 29 atolls and 5 islands in the Central Pacific Ocean. The total land area is 181 sq km. The Marshalls are inhabited by a single people who speak a single language. The total population was estimated at 59,071 in 2005.

The kinship system can be classified as matrilineal. While, land is inherited through the mother, chiefs traditionally have authority over land ownership.<sup>iv</sup> The natural environment is an essential element in traditional Marshallese culture, and the people identify very closely with the land and water. Traditional Marshallese culture depended on the gathering of reef and open water resources. Taro, coconut, arrowroot, and pandanus were cultivated, utilizing the fresh water lenses beneath the surfaces of many of the small islets in the Marshall Islands.

*Historical antecedents.* It is uncertain when Micronesian navigators first settled the Marshalls. Sighted by Spanish explorers in the 1500s, the islands take its name from British captain John Marshall, who explored them in 1788. The Marshall Islands were claimed as a colony by Spain in 1874 and subsequently sold to Germany in 1899. Japan took over Germany's colonies in Micronesia at the outset of WWI. Following WWII, the Japan's Pacific colonies became the Trust Territory of the Pacific Islands, under a United Nations mandate. The U.S. kept the Marshall Islands in 'trust' from 1947 until 1989, when the United Nations confirmed the termination of the Trusteeship Agreement. Having taken the military base at Kwajalein during WWII, the U.S. turned this facility into the base of operations for testing its thermonuclear weaponry from 1946 to 1958, including the 15 megaton Bravo test of 1954. These tests rendered Bikini and Enewetak uninhabitable, and exposed the people of the Marshall Islands, notably on Rongelap and Utrik, to radioactive fallout. Many of the people displaced by nuclear testing are now living in Ebeye and Majuro (the capital atoll).

The U.S. military built a missile testing range in Kwajalein atoll in 1961. The Ronald Reagan Ballistic Missile Defense Test Site (RTS) has been the main military base serving as the target of intercontinental ballistic missiles (ICBMs) launched from California. More recently, the RTS has been utilized as the launch site for testing the ballistic missile defense system (BMDS).

Although a measure of self-government for the Marshallese people began in 1979 with the approval of its constitution, the economy of the Marshall Islands has been largely dependent upon the rent that the U.S. pays for the RTS, compensation for nuclear testing, and various forms of aid, totaling a billion dollars over the period 1986-2001.<sup>v</sup> However, adequate funds have not been allocated for the local government of

Ebeye to consistently provide basic public services such as sewers, electricity, and water.

*Modes of living: population aspects.* Ebeye Island is the second major population center of the Marshall Islands. As of 2000 its 9345 people lived in an area of 0.36 km<sup>2</sup> (66 acres, a density of 26,790/km<sup>2</sup>).<sup>vi</sup> As a population center, Ebeye is a creation of the U.S. military. The Japanese colonial census of 1930 counted nine people on Ebeye. The rise in population was initiated in 1951 when 559 people were moved from a Marshallese workers' village on Kwajalein Island to Ebeye.<sup>vii</sup> Having originally built homes for the displaced, the US military underestimated the actual needs and made inadequate provisions for the growth of the population. A desalination plant and an electric plant were built without adequate plans for maintenance. When it became evident that the housing and infrastructure designed by the US military were insufficient, adequate additional measures were not implemented.

Many of the people of Ebeye at present can be considered internally (within country) displaced persons - some displaced from their home islands by thermonuclear weapons, others displaced from the central corridor of islands of Kwajalein Atoll by the ballistic missile range. Others migrated to Ebeye from other atolls because of the availability of jobs and the lure of cosmopolitan society. Traditional cultural obligations mandate that those already living on Ebeye take in family members who choose to migrate. The influx of displaced persons and migrants has led to overcrowding on Ebeye, with approximately nine persons per household.<sup>viii</sup> Much of the housing on Ebeye is of plywood construction, with corrugated iron/aluminum roofs, and no running water. Traditional foods such as breadfruit, coconut, and reef fish are relatively unavailable on Ebeye. Nearly all of its food is imported, with a heavy reliance on processed/manufactured foods such as white rice and canned meats.

*Arrangements of power and property.* Because of the formal political "independence" of the Marshall Islands, the U.S. is able to avoid responsibility for conditions in Ebeye. Despite the harsh living conditions, Ebeye's proximity allows for the Reagan Test Site (RTS) to have a ready and willing manual labor force to support its operations.

The local government essentially has no land use zoning or plan. This is primarily due to the preservation in the Republic of the Marshall Islands (RMI) of traditional land rights. The traditional chiefs/landowners of Kwajalein have

become extremely wealthy as recipients of the rent payments (\$180 million from 1986 to 2001<sup>ix</sup>) for the use of Kwajalein Atoll by the RTS. Some of these individuals are also active in modern politics. They have a vested interest in seeing that the current system remains in place, though they would like to receive more compensation for the use of the land.<sup>x</sup>

*Kwajalein Island*, in contrast, is the largest island in Kwajalein Atoll, with an area of 3.1km<sup>2</sup>. The population of Kwajalein Island ranges from 2,000 to 4,000 (a density of 1,300 per km<sup>2</sup> for 4,000) depending on the level of activity surrounding the tracking of intercontinental ballistic missiles (ICBMs) and ballistic missile defense. The island is under U.S. military command but is run by private contractors. Raytheon Systems Engineering, a branch of the Massachusetts-based Raytheon Corporation, was the primary contractor at the time of the cholera outbreak. (In 2002, the contract was awarded to a consortium of Bechtel Corporation and Lockheed Martin.) Most of Kwajalein's expatriate American population works for such private contractors. Kwajalein Island has bungalows, broad streets, a golf course, and swimming pools. Its restaurants and markets are stocked with fresh fruits and vegetables. Kwajalein Island has plentiful water, obtained from rain catchment off of the runway.

The relationship between residents of Ebeye and those of Kwajalein are clearly demarcated by race to the extent that racial differences and discourses are reflected in the hierarchy of labor and base access. There are actually very few military personnel on Kwajalein. Most of Kwajalein's long-term residents are civilian employees of defense contractors and members of civil society such as school or hospital workers. While there is some racial diversity among the workers on Kwajalein, their U.S. citizenship sets them apart from the Marshallese, particularly in that their living conditions are privileged in stark comparison to the residents of Ebeye. The demands for security on a military base effectively keeps Americans apart from Marshallese. We have observed Marshallese on the streets being stopped and questioned by security personnel. The few Marshallese professionals that live on Kwajalein at times express discomfort about staying on Kwajalein, despite the much desired standard of living. A novel which effectively portrays the relations between Marshallese and Americans living in Kwajalein Atoll is Robert Barclay's *Melal*.<sup>xi</sup>

## Discussion

Theoretical models of health and disease attempt to explain the distribution and production of disease. Within clinical medicine, the utility of the reductionist biomedical paradigm has been questioned for decades,<sup>xii</sup> and the limits of the biopsychosocial model are also becoming apparent. The Marshall Islands has previously served as an example for us to critique the biopsychosocial model from a political economic perspective.<sup>xiii</sup> A more encompassing view attempts to place the entire human experience within the context of the ecosystem. VanLeeuwen and colleagues'<sup>xiv</sup> focus is on the determinants of health rather than a method for outlining disease production. Krieger suggests an approach that integrates the political economic into the ecological, providing a theoretical basis for identifying disease production from an *ecosocial* perspective.<sup>xv,xvi,xvii,xviii,xix</sup>

Krieger outlines fundamental aspects that should be described:

1. Embodiment
2. Pathways to embodiment
3. Cumulative interplay between exposure, susceptibility, and resistance
4. Accountability and agency

We attempt here to explicitly apply the ecosocial approach to the epidemic of cholera in the Marshall Islands.

### *Embodiment*

Embodiment refers to the mechanisms by which humans as biological organisms incorporate their material and social worlds. Embodiment cannot be understood without reference to historical processes and individual and social modes of living. The distribution of health and disease reflect the connections between bodies and the body politic.

Cholera occurred on two islands among hundreds of islands in the archipelago of atolls that form the Marshall Islands: Ebeye Island (population 9,345, 400 cases, six deaths) in Kwajalein Atoll and Lae Island (population 322, 40 cases, no deaths) in nearby Lae Atoll. *Vibrio cholerae* O1, biotype El Tor, serotype Ogawa was isolated. In order to contain the cholera epidemic to Ebeye Island, workers commuting to nearby Kwajalein Island had to be certified that they were either taking prophylactic antibiotics or had received vaccination. The Federated States of Micronesia (a neighboring jurisdiction) provided the CVD-103hgr vaccine (Orochol Berna), and a high-risk population was vaccinated. The Centers

for Disease Control and Prevention sent a team to conduct a case-control study to determine risk factors for contracting cholera. Drinking water from Kwajalein Island, particularly if transported in open containers, was found to be a risk factor for contracting cholera.<sup>xx</sup> A campaign to promote the use of containers with spouts and tight-fitting lids was undertaken. Subsequently, Kwajalein Island authorities helped set up fresh water tanks on Ebeye Island.

Obviously, a necessary antecedent for cholera is exposure to *Vibrio cholerae*. From a biological standpoint, the ingestion of the bacterium, generally occurring via fecal-oral transmission, is required for the occurrence of the disease. Most commonly the sources by which the bacterium is spread are contaminated water and inadequately cooked food.

How, then, did it come about that people on Ebeye came to embody cholera as a fatal-for-some disease state? How did they come to ingest contaminated food or water? Why did some die of it? Conversely, why was the embodiment of cholera not seen on Kwajalein?

As Krieger notes, “bodies tell stories about – and cannot be studied divorced from – the conditions of our existence.”<sup>xxi</sup> Thus, we maintain that the answers to these sorts of questions about the distribution of cholera in the Marshall Islands are to be found in the “social, material, and ecological contexts.”<sup>xxii</sup>

#### *Pathways to embodiment*

The pathways to embodiment are structured by (a) arrangements of power, property, patterns of production, consumption, and reproduction, and (b) human biology as it has been shaped by evolution, ecological contexts, and individual life histories. To understand these pathways, we must again take into account the relevant historical, geographical, and social background. Thus, in the Marshall Islands, specifically in the Ebeye-Kwajalein complex, power and property are in the hands of the military, the armaments corporations, and the landowners who receive the rent. Those on the political and economic margins, the laborers and their families, those who depend on hand-carried water for their bodily sustenance, find that their bodies are the ones on which the epidemic of cholera is writ.

*Ecosystem conditions.* While the WHO recommends for refugee situations that refugees be provided with 15 to 20 liters per day of clean water - at the time of the cholera outbreak, people on Ebeye did not have access to such a supply as a

matter of routine. Rather, they struggled daily with the dearth of clean water.

Prior to the construction of the RTS few people lived on Ebeye, as fresh water was scarce. Ebeye’s natural aquifer was overused and depleted. It is now covered by corrugated tin and plywood houses, paved roads, and coral rock paths. What greenery there had been was cut down to make room for housing. Currently, agriculture is impossible on Ebeye because of the lack of arable land. Thus, overcrowding has destroyed what little natural resources Ebeye possessed, and the people of Ebeye are completely dependent on imported goods for their subsistence.

Occurring in the Marshall Islands as part of the pandemic, cholera had to have arrived from somewhere, possibly in the bilge water of oceanic shipping.<sup>xxiii</sup> While military-dominated Kwajalein atoll is not a transit point for commercial fishing as is Majuro, the capital atoll, Ebeye’s dock serves as the entry point for all goods that enter Ebeye. Thus, it may be that dependence on imports encouraged the entry of cholera into the Marshall Islands.

*Human biology as it has been shaped by ecological contexts.* The destruction of the natural environment has been noted above. Although annual rainfall is 266 cm (105 in.) per year, rainwater catchment facilities are inadequate. At the time of the cholera outbreak, there was no running water on Ebeye. The desalination plant had not been maintained, and functioned only intermittently until 2002. Even when the plant was running, it often could not sustain adequate water pressure due to illegal access to the lines. Moreover, publicly supplied water is not potable. Therefore people on Ebeye supplemented their catchment supplies by water transported by hand via plastic containers on the ferry from Kwajalein island. This was a task assigned to youth and young men. Workers on Kwajalein would also bring home water each night.

The sewer system in Ebeye functions poorly; it takes water to run a sewer system. It is often clogged by trash. When it rains, the streets overflow with standing water contaminated by sewage. When the drains are functioning, raw sewage pours into the lagoon, close to a small beach where children swim and play, and the dock where people fish.

As noted above, residents of Ebeye who relied on water from Kwajalein Island, that is, those who did not have their own catchment facilities, were found to be at higher risk of contracting cholera. As the water at the tap on Kwajalein Island was

adequately chlorinated,<sup>xxiv</sup> this implies that the people who relied on transported water were unable to maintain adequate hygiene.

#### *Cumulative interplay between exposure, susceptibility, and resistance*

Exposure, susceptibility, and resistance are conceptualized at various levels (from individual to the international) and in a variety of domains (such as the home or work) in relation to ecological niches. The interplay occurs in multiple scales of time and space.

The reasons why people on Ebeye were exposed to the cholera *Vibrio*, while people on Kwajalein were not, should be evident from the above portrait of the disparate living conditions between the two islands.

A variety of factors may contribute to increased susceptibility and lowered resistance to infectious diseases among the people on Ebeye. One such factor is the high prevalence of diabetes mellitus. The lack of fresh fruit and vegetables and the importation of alcohol, white rice and high fat, high salt, processed foods have resulted in epidemics of obesity<sup>xxv</sup> and diabetes.<sup>xxvi</sup> We have found that, age-adjusted to the world standard population, the prevalence rate for diabetes in Ebeye adults  $\geq 20$  years of age is 20%<sup>xxvii</sup> Compare this to a world prevalence rate of 4.0% in adults  $\geq 20$  years of age<sup>xxviii</sup> and a U.S. crude prevalence rate (in an older population) of 8.6% in adults  $\geq 20$  years of age.<sup>xxix</sup>

Deficiency in vitamin A is well-documented in the Marshall Islands.<sup>xxx</sup> Poor nutrition in general<sup>xxxi</sup> and vitamin A deficiency in particular<sup>xxxii</sup> are associated with poor outcomes in diarrheal disease. Multiple episodes of diarrheal disease in children lead to underweight and poor resistance to further insults.

The immune systems of the people of Ebeye might also be adversely affected by psychosocial stressors such as dispossession from one's home islands, concerns about the lingering effects of nuclear testing, and the experience of systemic segregation within the Ebeye-Kwajalein complex.<sup>xxxiii</sup>

The cholera epidemic aside, it is evident that the Marshallese people are not in a robust state of health. According to the WHO, the child mortality (probability of dying before age 5) in 2001 in the Marshall Islands was 37/1000 for boys and 48/1000 for girls. Life expectancy at birth was 60.7 years for men and 64.3 years for women.<sup>xxxiv</sup>

The interplay between exposure, susceptibility, and resistance involve the health system of Ebeye. Run by the government (there is no private practice), the health services were severely stressed by the cholera outbreak. At the time of the cholera outbreak, Ebeye hospital had no running water. The antibiotics for this particular epidemic came from the US. The vaccine came from the Federated States of Micronesia. Most of Ebeye hospital's physicians, who cared for the cholera victims, were expatriates from the Philippines.

#### *Accountability and agency*

Firstly, who, among social groups or individuals, is responsible for the occurrences of embodiment? Secondly, those who describe the phenomena in question must take responsibility for their analyses. It follows that those who conduct studies should explicitly state the levels and scales of their work. The epidemiologists who studied the cholera outbreak are to be commended for their concern for the health of the Marshallese. Nevertheless, their analysis in terms of behavioral risk factors decontextualizes the epidemic by ignoring the underlying causes of its distribution. From the outset, they examine Ebeye only in terms of "risk factors" rather than considering the embedded social relationships and power dynamics within the Ebeye-Kwajalein complex or the larger political economy.

Thus, we need to examine not only the ways in which political economic and ecological conditions led to cholera – but, in order to address them, also who is responsible for creating those conditions.

Those in the local government who have benefited from the rent paid to them for the use of Kwajalein Atoll for the RTS bear some measure of responsibility for the well-being of their citizens. The U.S. makes payments to a small number of landowners, who gain personal wealth, instead of meeting the need of the populace for decent living conditions.

The Republic of the Marshall Islands, ostensibly independent since the end of the Trusteeship in 1989, continues to be dominated by the U.S. The U.S. dollar is its currency. Its people have the right to free entry into the U.S. Its economy and its government are dependent on financial assistance from the U.S. The Marshall Islands consistently votes in line with US interests in the UN. Between 1986 and 2001 the U.S. provided \$1 billion in support to the Marshall Islands.<sup>xxxv</sup> In the compact negotiations the

Marshall Island's only bargaining chips are access to its territorial waters and the RTS.

U.S. strategic policies of maintaining global military superiority, manifested by the development of a nuclear arsenal in the post-World War II period can be thus identified as a fundamental cause of the conditions under which the people of the Marshall Islands live.

The use of the Marshall Islands for nuclear weapons testing created a population of refugees, many of who live on Ebeye today. Also, the people of Ebeye contribute a 1000-1200 person manual labor force to support the operation of the RTS,<sup>xxxvi</sup> where they largely perform tasks such as cooking, cleaning, and hauling. Workers arrive every morning on a converted landing craft and place their hands on a machine that reads their handprints in order to gain admission onto Kwajalein Island. When their shifts are over, they have three hours to return to Ebeye. The workers are not allowed to live on or stay overnight on Kwajalein Island. Exceptionally few Marshallese, mostly professionals and their families, are allowed to live on Kwajalein Island. Nonetheless, as there are few large employers besides the RTS in the Marshall Islands, these jobs on Kwajalein Island have drawn people to Ebeye from all over the archipelago. Having built the RTS and Ebeye, the U.S. military has not provided the necessary infrastructure and maintenance support to ensure a livable environment on Ebeye.

The private contractors who employ the people on RTS benefit from the ability to draw upon the low-wage labor pool on Ebeye. In 2002, the contract to run the RTS passed from Raytheon Corporation to a consortium of Lockheed-Martin and Bechtel, all among the largest arms manufacturers in the world. Many other contractors also partake in RTS activities. As Chomsky notes:

*[D]omestically the Pentagon always was, and was understood to be from the late 1940s, a method by which the government can coordinate the private economy, can provide welfare to it, can subsidize it, can arrange the flow of taxpayer money to research and development, provide a state guaranteed market for excess production, and target advanced industries for development, etc.*<sup>xxxvii</sup>

*[A]fter World War II, U.S. business leaders . . . understood that social spending could play the same stimulative role, but it is not a direct subsidy to the corporate sector, it has*

*democratizing effects, and it is redistributive. Military spending has none of these defects.*<sup>xxxviii</sup>

In these ways, the responsibility for the overcrowded conditions and ecological problems on Ebeye rests jointly with the local leaders, the RTS, its private contractors, the U.S. government, and the corporate class.

## Conclusion

What lessons can we draw from our examination of cholera in Ebeye from an ecosocial viewpoint? What can we do in practice in order to help prevent such occurrences in the future? We suggest that those committed to the social good of health, including health care workers and public health practitioners, should work to identify the underlying causes of disease production and strive to eliminate them.

In modern cosmopolitan medicine, the reductionist biomedical approach to disease continues to dominate. But modern biology, particularly in the area of ecology, views outcomes as a result of a complex interplay at many levels. Social science, too, searches for ways to understand the interaction between the micro and the macro. Theory in health and disease must follow suit and recognize that disease also occurs beyond the microscopic level and even beyond the individual.

As Levins and Lewontin note, unregulated industrial capitalism is as much a cause of tuberculosis as the mycobacterial bacillus. Medicine's identification of the bacillus as the cause of tuberculosis is a matter of social practice. From this, it follows that the remedy for tuberculosis is antibiotics rather than measures to ameliorate, let alone oppose, industrial capitalism.<sup>xxxix</sup>

Of course, this is not to deny that antibiotics are not needed to cure tuberculosis. Indeed, as Farmer notes with regard to epidemics of multidrug-resistant tuberculosis, we are faced with a need for more biomedicine (susceptibility testing, supplies of appropriate medications), properly applied.<sup>xl</sup> Thus, physicians in Ebeye would appreciate more resources to better care for the various afflictions of the people of Ebeye.

A broad approach to disease causation is not promoted, not taught, and therefore easily ignored. The overwhelming scope entailed by an ecosocial perspective is a hindrance to widespread acceptance of this form of looking at disease production within the medical community.

Divorced from their applications theories can be difficult to grasp. Thus, we have sought to apply Krieger's ecosocial approach to a specific epidemic, partly in order to assess the utility of the theory. We view the epidemic as the biologic embodiment of differentials in political power, disparate economic conditions and ecological imbalance.

Courses of action that may prevent future outbreaks might include (1) advocating that U.S. compact payments to the Republic of the Marshall Islands go to improvement and maintenance of the infrastructure and health care system, (2) and opposing the system of racial separation in Kwajalein/Ebeye. As health workers concerned with understanding and addressing the inequalities of health among the Marshallese, this is our duty.

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