

## ***Reported Anthrax Disease in Costa Rica - Is it Accurate?***

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### **Abstract:**

Recently, the potential use of anthrax spores as a biological weapon has increased awareness and increased interest in this potentially deadly bacteria (3). The purpose of this research project was to perform an extensive critical investigation using qualitative data that focuses on the accuracy of the reporting of cutaneous anthrax disease in Costa Rica. This issue of accurate reporting of infectious disease such as is of paramount importance because it is often these reports that are the basis of surveillance and prevention programs. Additionally, inaccurate reporting indirectly affects priority, resources, and education programs given to other infectious diseases. The methodology utilized to evaluate the accuracy of reported Anthrax disease in Costa Rica involved multiple resources. The qualitative data was derived from interviews with key informants involved in multiple disciplines of health care. The key informants included local and regional human and veterinary health workers and officials, local and regional clinical and veterinarian laboratories, and officials of the Ministry of Health. The interviews were conducted in an organized and systematic fashion using open-ended questions to maintain objectivity. A mock diagnosis of anthrax disease in the veterinarian laboratory of the National University in Heredia, Costa Rica was performed under the direction of Dr. Magaly Caballero. This experience provided a better understanding and first hand experience with the diagnostic protocol. This information allowed for a logical synthesis of information on which recommendations for steps to improve the reporting anthrax are made. Data from secondary sources included a review of the literature, including publications from the Costa Rican Ministry of Health, and electronic data gathering from the internet. The synthesis of information based on the collected data yielded the following results: 1) The classification and clinical description of anthrax disease is not uniform among medical text resources 2) The quantity (11 cases) of reported anthrax disease in Costa Rica between 1987 and 1996 is likely an overestimation and the true incidence of the anthrax infection caused by *Bacillus anthracis* may in fact be zero 3) The surveillance programs should be improved 4) The diagnosis of anthrax disease by one laboratory is insufficient with regard to the importance of accurate. It can be concluded from the research presented in this paper that the reporting of anthrax disease in Costa Rica between 1987 and 1996 is likely inaccurate and that further steps should be taken to improve future reporting of anthrax disease in Costa Rica. These steps include ensuring accurate clinical presentation descriptions and classification in medical resources relied on by health professionals, secondary confirmation of anthrax disease by a second independent laboratory, and improving surveillance by creating an "Anthrax Watch Team."

### **Introduction:**

***The state of the art.*** Anthrax is an acute infectious disease caused by the spore-forming bacterium *Bacillus anthracis*. Anthrax most commonly occurs in warm-blooded plant-eating animals (goats, sheep, cattle, swine) but can also infect man. It is most common in agricultural regions including South and Central America, Southern and Eastern Europe, Asia, Africa, the

Caribbean, and the Middle East. When anthrax affects humans, it is usually due to an occupational exposure to infected animals and animal products.

Anthrax infection can occur in three forms: cutaneous, inhalation, and gastrointestinal. The incubation period between infection and the onset of symptoms is typically 7 days. Most anthrax infections exist in the cutaneous form which accounts for about 95% of cases. Skin infection occurs when the bacterium enters a cut or abrasion on the skin when handling contaminated wool, hides, leather or hair products of infected animals. It begins as a raised pruritic bump resembling an insect bite and develops into a vesicle in 1-2 days which is followed by a painless ulcer with a black necrotic center. Local lymph nodes may be involved. There is a 20% mortality rate without treatment but death is rare with appropriate antimicrobial therapy.

The inhalational form (“wool sorters” disease) accounts for less than 5% of human cases (1). Initially, inhalational anthrax symptoms are nonspecific and resemble an upper respiratory infection with low grade fever, a dry hacking cough and weakness. It is an illness with a biphasic course with widened mediastinum on chest x-ray and often accompanied by hemorrhagic meningitis (2). After 2-4 days there may be a brief period of improvement but within 24 hours of this improvement respiratory distress, shock, and death occur quickly.

The rarest form accounting for between 1 and 5% of cases is intestinal disease which follows the consumption of contaminated meat and is characterized by an acute inflammation of the intestinal tract. Signs include nausea, anorexia, vomiting and fever followed by abdominal pain, hematemesis, and severe diarrhea. Death occurs in 25-60% of cases.

Recently, the potential use of anthrax spores as a biological weapon has increased awareness and increased interest in this potentially deadly bacteria (3). The global incidence, estimated by Glassman, of anthrax in 1958 was between 20,000 and 100,000 cases annually (12). The frequency of the disease today is less than it was in 1958 largely due to intensive livestock immunization programs which have greatly reduced the occurrence of anthrax disease among both animals and humans in much of the world. The true frequency today, however, is largely unknown. This is in part because although anthrax as a reportable disease in many countries including Costa Rica, there are a significant number of countries in which it is not reportable, including approximately half of Africa. Because anthrax spores can remain viable for several decades under suitable environmental conditions, absence of cases does not equate to absence of risk.

The importance of reducing the risk of anthrax through international collaboration in health education and training was discussed by the World Health Organization (WHO) in September of 1995 (4). Among priority concerns identified by the WHO were 1) identifying areas, countries and regions of major risk 2) promoting public awareness and information through education on anthrax in infected areas and 3) providing advice on how to prevent the introduction of anthrax in countries or areas where the incidence is very low.

Table 1 depicts the *reported* incidence of anthrax compared with three other reportable diseases in Costa Rica between 1987 and 1997. This table is included to provide the reader with an idea regarding how uncommon reported anthrax is in Costa Rica.

**Table 1**

Cause	Anthrax No. / Rate	Brucellosis No. / Rate	Cholera No. / Rate	Tetanus No. / Rate
1997	0	5 / 0.1	2 / 0.6	2 / 0.1
1996	0	2 / 0.1	36 / 1	3 / 0.1
1995	4 / 0.1	4 / 0.1	24 / 0.7	6 / 0.2
1994	0	5 / 0.2	37 / 1.1	4 / 0.1
1993	1 / 0.03	8 / 0.2	13 / 0.4	2 / 0.1
1992	1 / 0.03	4 / 0.1	19 / 0.6	1 / 0.03
1991	3 / 0.1	3 / 0.1	0	1 / 0.03
1990	1 / 0.03	8 / 0.3	0	2 / 0.1
1989	1 / 0.03	7 / 0.2	0	2 / 0.1
1988	0	4 / 0.1	0	4 / 0.1
1987	0	6 / 0.2	0	7 / 0.3

4 obligatory registered diseases in Costa Rica 1987-1997.

Rate = number of cases per 100,000 inhabitants

#### *Current Policy*

Current policies in Costa Rica regarding anthrax disease prevention and control consists of obligatory reporting and livestock vaccination. Anthrax disease in Costa Rica is a class c reportable disease which means that it must be reported within 1 week of diagnosis (5). According to the obligatory registered cases, there were 11 cases *reported* between 1992 and 1987, with 4 cases in 1995 being the most recent reported cases.

#### *Health Policy Question*

This paper focuses on the reporting of cutaneous anthrax disease in Costa Rica and offers suggestions on how the reporting can be made more accurate. The discussed issues include diagnoses and classification which are important factors influencing the reporting of anthrax disease. Finally, based on the data collected from this research, suggestions for improving the accurate reporting of this potentially fatal disease are offered.

#### **Methods:**

The data used for this research was compiled from multiple sources. The primary data source was comprised from interviews with key informants and included a mock diagnostic trial to gain first hand experience with the diagnostic protocol involved in making a diagnoses of anthrax disease. Secondary sources were used to provide data and background information in preparation for the interviews with key informants and to provide support for the conclusions and recommendations regarding the reporting of anthrax disease in Costa Rica. These secondary sources included a review of the literature and information on anthrax disease available on the internet, and publications from the Costa Rican Ministry of Health.

Key informants from the health care community included professors, physicians and

public officials involved in public health, microbiology, and the epidemiology of infectious disease in Costa Rica. These informants were interviewed using an open interview technique. This interview technique involved open-ended questions which increased the objectivity of the qualitative data collection methods. Key informants were identified initially by Dr. Mario Tristan, and by recommendations made by established key informants. The key informants who provided data, information, and opinions regarding the reporting of anthrax disease in Costa Rica included: 1) Dr. Elena Campos, Microbiologist at the Reference Laboratory, San Jose, Costa Rica 2) Dr. Leonardo Maranguelo, Epidemiologist and Advisor to the Ministry of Health, San Jose, Costa Rica 3) Dr. Magaly Caballero, Chief of Bacteriology, National University School of Veterinary Medicine, 4) Dr. Rosalia Barboza, Chief of the Fortune Clinic in Limon, Costa Rica 5) Dr. Seidy Hererra, Director of the Liberia Hospital 6) Dr. Marta Arguedas, Director of the Area of Health at the Social Security Bureau Clinic in Canas and 7) Dr. Ligia Carballo, Microbiologist at the Social Security Bureau Clinic in Canas.

Dr. Campos, a microbiologist working at the Reference Laboratory INCIENSA in San Jose, discussed a case that occurred approximately 20 years ago in which a cow was being investigated because of death caused by severe hemorrhage from mucous membranes and hematemesis. After completing an on-site investigation, the investigator became ill and died within a couple of days. Given the epidemiological surveillance programs in place at the time of this case report, the details regarding the case are unavailable thus no conclusions can be based on this case.

Dr. Maranguelo, who has worked as an epidemiologist at the Ministry of Health of 35 years, was interviewed (Feb 2, 1999) and stated that the major problem with accurate reporting of anthrax is the potential miss-classification of anthrax as a staphylococcal infection. According to Dr. Maranguelo, the 11 reported cases between 1987 and 1996 need to be investigated further regarding the diagnostic methods used that led to the diagnoses of anthrax disease. He is of the opinion that because of discrepancies in classification descriptions present in medical texts, these cases may not have been anthrax disease but rather staphylococcal infections. He presented information on anthrax, which described cutaneous anthrax as a folliculitis under the same classification as staphylococcus (6). Without the actual case reports, it is difficult to support or deny this possibility. Although this situation seems unlikely because of different clinical presentations, it is possible due to lack of awareness of anthrax disease and incomplete investigation with appropriate cultures. The primary differences in presentation between a staphylococcal infection and cutaneous anthrax disease is that the former presents with a painful ulcer with pus versus the non-painful necrotizing ulcer without pus that occurs in cutaneous anthrax disease. If the cutaneous lesion of anthrax disease becomes secondarily infected with staphylococcus, it may be difficult to differentiate the ulcer based on clinical presentation alone.

Dr. Magaly Caballero is the Chief of Microbiology at the National University School of Veterinary Medicine in Heredia, Costa Rica. She has worked there as a microbiologist for the past 13 years and reports she has not seen a single case of documented anthrax disease in animals or humans. She believes that there is no endemic anthrax in Costa Rica. This belief is based on the hypothesis made by Dr. Manuel Chirino-Trejo of the Western College of Veterinary Medicine at the University of Saskatchewan (Saskatoon, Canada) who studied the pH of the soil in various parts of Costa Rica and found the pH to be acidic. According to Dr. Caballero, the

*Bacillus anthracis* spores do not survive in a basic soil (7). In addition, she stated that because livestock in Costa Rica are vaccinated against anthrax, the threat of endemic anthrax disease is low. Therefore, she believes the greatest threat of anthrax in Costa Rica is from imported animal products. However, she cautions that it can be a lethal disease and that those animals suspected of having anthrax should be handled in an appropriate manner and that physicians and those working with the Ministry of Health should act on any suspicion of anthrax disease should quickly so that a diagnoses can be made and treatment begun.

Information on diagnostic procedures for anthrax disease was primarily obtained from Dr. Caballero's protocol and through an actual mock diagnoses in the laboratory. The diagnoses protocol is really a two-step procedure and is similar for animals and humans. The first step consists of the following: 1) obtaining the sample (either a blood sample or using a sterile swab from the cutaneous lesion). The blood sample should be obtained without the use of anticoagulants and characteristically the blood will not clot 2) Safety precautions must be observed including closing the lab, performing the diagnostic steps under a safety hood, donning a mask capable of filtering 1 - to - 5 um particles, gloves, and lab coat 3) the specimen is then streaked on sheep blood agar and on McConkey's agar for contaminants 4) The specimen is put on slides placed in a 1:1000 mercury chloride solution for 30 minutes. The sample is then stained with Methylene Blue that is at least 3 months old for one minute. The capsule of *B. anthracis* seems to take up the stain better with aged Methylene Blue and will appear as purplish-red capsule around the blue bacteria. The Methylene Blue solution is made using 30ml of 1% of 95% ethanol, 0.1ml of 0.001% aqueous hydrogen peroxide and 100ml of distilled water. 5) They are washed with distilled water and allowed to dry then viewed under light microscopy.

The second part of the diagnostic procedure involves lancing the tail of a mouse in such a way that the surface is broken just enough to induce a small amount of bleeding. A sterile swab is used to add the suspected anthrax sample to the blood of the mouse. If the sample contains anthrax the mouse will die within 48 hours, usually within 24 hours. If death occurs, anthrax should be isolated from the mouse. Either the blood or the spleen can be used to confirm the diagnoses. On completion of the procedure, all involved materials must be autoclaved and the mice cremated.

Data was also compiled based on site visits to clinics in the Central Valley and the province of Limon. Limon has a large rural population and a high incidence of infectious disease including the highest incidence of malaria in the country (8). An interview with Dr. Barboza at a clinic in the Valley of the Stars revealed that no cases of anthrax have been diagnosed since 1987. Records prior to this time were unavailable.

Dr. Herrera has been the Director of the hospital in Liberia for 4 years. Her prior medical experience in the Guanacaste area includes 4 years as an external consultant and 7 years with the Servicio Urgencias ( Emergencies Unit). She has not seen nor heard of any cases of anthrax in Guanacaste in the past 15 years she has been working there. Dr. Herrera believes that the probability for anthrax disease in Costa Rica is higher in the province of Guanacaste due to both its size, the largest of Costa Rica's seven provinces, and because of its large number of cattle ranches

Dr. Martha Arguedas Arce has been the Director at the Social Security Bureau Clinic in Canas (province of Guanacaste) for the past 3 years. She spent 3 years at the Hospital Golfito (Guanacaste), 1 year at the Nandayure clinic in Guanacaste, and 3 years in Family and Community medicine in the province of Cartago. She has never seen anthrax disease or heard of any cases in Guanacaste nor while previously in Cartago.

At the Social Security Bureau Clinic in Canas, Dr. Ligia Carballo, was interviewed, a microbiologist who has 22 years experience at this clinic. Like Dr. Arguedas, she also has never heard of any reported cases of anthrax disease.

### **Analysis and Policy Recommendations:**

Based on professional opinions and information learned during interviews with key informants in the health care community several conclusions and corresponding recommendations can be made. First, the classification of anthrax disease is not uniform in all medical texts. Discrepancies between medical sources regarding the clinical presentation of cutaneous anthrax disease can lead to misdiagnoses. The classification and clinical presentation of cutaneous anthrax disease described by medical texts should be consistent. In order to solve the potential problem of different classifications leading to misdiagnoses two recommendations are offered. The first is to correct the problem at the source by ensuring correct classification and clinical descriptions provided by medical references. Another possible solution is to target those involved in diagnoses of human cutaneous anthrax disease by providing accurate information at the medical school level. This solution relays on the fact that the medical references used by instructors are those that correctly classify anthrax disease. The implementation of the recommendation to eliminate discrepancies of classifying anthrax disease as a folliculitis or under the heading of staphylococcal infection involves establishing an international consensus and writing and publishing medical texts accordingly. At the medical education level, once a consensus exists, medical students should be taught about the classification, clinical presentation, diagnoses, and treatment of anthrax disease.

The laboratory diagnoses of anthrax disease are relatively straightforward. This is based on our experience during a mock anthrax disease diagnostic trial under the supervision of Dr. Magaly Caballero and an in depth discussion about the diagnostic protocol. A false sense of security may be provided by the relative ease in which the diagnoses can be made in the microbiology laboratory. A recommendation is made that all anthrax disease diagnosed in the one laboratory should be confirmed by diagnoses in an independent laboratory.

If indeed reported anthrax disease in Costa Rica is a result of misclassification and there is in fact no anthrax disease, three recommendations are offered. The first recommendation is that the emphasis on current recommendations regarding anthrax disease provided by the World Health Organization (WHO) should be shifted. Increased emphasis should be placed on providing advice on how to prevent the introduction of anthrax disease into Costa Rica from foreign countries. Programs promoting public awareness through education are still important for those occupations at increased risk but they are less critical for the general population.

The second recommendation is that the methods of reporting and information flow be analyzed. Costa Rica does have regulations for the reporting of anthrax disease. The problem of inaccurate reporting, if this is indeed the case, more likely stems from failure to implement regulations, rather than from their non-existence. An evaluation of the surveillance program and reporting methods should involve multiple levels. The local level includes private and public clinics and physicians. This is the level at which the first interaction with an infected patient and health personnel occurs. At this level, methods of data collection should be investigated. At the intermediate level, an analysis of data from local levels occurs in addition to epidemiological investigations and tracing the source of human infection to animals or animal products. This level should provide feedback to the local level and report to the central level. The central level is in charge of allocating resources such as technical and laboratory support to the intermediate level. It is at this level where policies are made and from which the WHO receives reports regarding anthrax disease.

The third recommendation to consider is the implementation of the “Anthrax Watch Team” concept previously described by the WHO. This team would consist of an animal health or livestock officer such as a veterinarian who is knowledgeable about the proper diagnostic and specimen collection methods, a laboratory technician, and personnel trained in site decontamination and proper handling of infected animals.

**Conclusions/Summary:**

Anthrax disease is a potentially fatal disease if untreated and has recently gained publicity because of its potential use as a biological weapon. It is known that the Anthrax has been used as a threat and some samples of the spores have been illegally taken from several laboratories in California and in other parts of USA. Knowledge of anthrax is necessary for public health officials as well as health care providers who may be faced with making the diagnosis and offering treatment to those at-risk populations. The data collected from this research suggests that reported anthrax disease between 1987 and 1996 may indeed be inaccurate. It is clear that this issue should be resolved in order to prioritize prevention methods. It is also important to point out that anthrax has not been a public health problem, despite that cattle production in Costa Rica is quite large. The health policy regarding this despite of the ecological limitation for “*Bacillus anthracis*” must be also analyzed).

**References:**

1. Gold H: Anthrax: A report of one hundred seventeen cases. Arch Intern Med 96: 387-96, 1995.
2. Penn C: Anthrax Pneumonia. Seminars in Respiratory Infections 12: 28-30, 1997.
3. Pile J: Anthrax as a Potential Biological Warfare Agent. Arch Intern Med 158: 429-434, 1998.
4. Bulletin of the World Health Organization. 74 (5): 465-470, 1996
5. Enfermedades de Denuncia Obligatoria. La Gaceta 92: 1-12, 1983
6. Clasificación Estadística Internacional de Enfermedades y Problemas, Relacionados con la Salud, Publicaciones Científicas 554, WA, OPS (PAHO), 1995: 10th edición, Vol 1, 114-115
7. Caballero Magaly, Personal Communication, February 1999, Reference unknown
8. Memoria Anual, Ministerio de Salud, Costa Rica, 1998.
9. Quinn, P.J. Clinical Veterinary Microbiology. Mosby-Year Book Europe Limited, 1994: 178-183
10. Balows, Albert. Manual of Clinical Microbiology 5th edition. American Society for Microbiology, Washington D.C., 1991: 296-303
11. Botlone, Edward. Schneierson's Atlas of Diagnostic Microbiology, 8th edition. Abbott Laboratories, Chicago, IL, 1976: 4-5
12. Wolfgang, Bisping. Colour Atlas for the Diagnosis of Bacterial Pathogens in Animals, Paul Parey Scientific Publishers, 1988: 72-79
13. Koneman, Stephen D., Color Atlas and Textbook of Diagnostic Microbiology, 2nd edition, Lippincott, 1983: 328-330
14. Glassman, H.N. World Incidence of Anthrax in Man. Public Health Rep., 73: 22-24: 1958