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Contributors

Chuka Agunwa, Emmanuel Obi, Haleluya Moshi, Kip Thompson, Helena Ribeiro, Viviana Mendes Lima, Sandra Costa, Anderson Chimusoro, Juliet Nabyonga-Orem, Portia Manangazira, Isaac Phiri, Stephen Maphosa, Ottias Tapfumanei, Sydney Danda, Tonderai Nhende, Stanley Munyaradzi Midzi, David Claborn

Notice

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Meet the editor

David Claborn is the Director of the Master of Public Health Program at Missouri State University where he teaches courses in Environmental Health and International Health. He was awarded a Doctor of Public Health (DrPH) degree in 2001 from the Uniformed Services University of Health Sciences in Bethesda, Maryland, where his dissertation dealt with the reintroduction of malaria in South Korea. Prior to his academic career, he was a medical entomologist for the US Navy from which he retired at the rank of commander in 2008. He lives in Springfield, Missouri, with his wife, daughter and two rescue dogs.

Contents

Preface

The differences between "international health" and "global health" are not well defined; many use the terms interchangeably. Both fields seek to address health issues that cross borders and present hazards to diverse populations across the continents and the world. For some public health workers, international health addresses issues for all other countries except the one in which an individual public health worker resides. This definition is not very useful as it depends strictly on an individual's perspective. Some observers have suggested that global health requires a multi-disciplinary perspective to trans-border health issues, including fields such as anthropology, psychology, engineering, law, history, clinical medicine and, of course, public health. This definition seems more useful and is consistent with the current volume entitled *Current Issues in Global Health*. The chapters presented here include examples from the fields of medicine, psychology, military public health and humanitarian relief…even business. What ties them together is a focus on human health and efforts to ensure health through good science and well-designed research. The very nature of the field of global health requires researchers and practitioners from many lands who speak different languages to communicate in a common medium. That communication is often imperfect, but no less important. This book seeks to provide a medium for communication across languages and cultures on topics of global health importance.

David Claborn, DrPH
CDR USN (ret.)
Master of Public Health Program
Missouri State University, USA

Section 1

Background and History of the Field

Chapter 1

Introductory Chapter: What Is Global Health?

David M. Claborn

Additional information is available at the end of the chapter

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1. Introduction

A useful definition of "global health" is an elusive prey, hiding among its congeners of public health, international health, tropical public health, and global health governance. Some use the terms "international" and "global" interchangeably, though others contend that "international" is a more limited term used to describe health issues in the developing world from the perspective of the developed world. In other words, international health is the study of health in countries other than one's own, especially if the other countries are representatives of the developing world. This perspective on international health expanded during the period of European colonialism [1], contributing to the establishment of many leading public health institutions such as the London School of Hygiene and Tropical Medicine (founded in 1908) and the Institute of Tropical Medicine-Antwerp (founded in 1906). In the New World, the construction of the Panama Canal prompted the United States to focus on the tropical conditions that nurtured epidemics of yellow fever and malaria amongst the workers on the canal. Several professional organizations were started during this period to address the health risks provided by international trade and travel, including the American Society of Tropical Medicine and Hygiene (founded in 1903) and the Royal Society for Tropical Medicine and Hygiene (founded in 1907).

As Europe and the international community sought to distance themselves from the controversies and outright exploitation of colonialism, public health authorities sought to diminish the perceived paternalism inherent in the accepted definition of international health. Public health events also demonstrated the ability of health issues to transcend borders, presenting threats to rich and poor alike. The Spanish influenza pandemic of 1918 may have killed as much as 5% of the world's population at the time. Although morbidity reports at the time were suppressed due to concerns about divulging troop vulnerabilities in several combatant countries during WWI, the pandemic clarified the need for greater knowledge about transnational disease threats [2]. And, it was obvious that the developed world was not immune

to such pandemics. Over 50 years later, the pandemic of AIDS demonstrated that infectious diseases were resilient and could still threaten the developed and the developing countries of the world alike, though it was obvious that the risk of disease was greater in the developing world. In fact, some relatively wealthy nations such as the Soviet Union and Venezuela suffered catastrophic conditions as their public health and health care systems collapsed as a result of financial and political crises, leading to resurgent tuberculosis, diphtheria, and, in the case of Venezuela, malaria [3, 4]. The perspective of international health from the safe harbor of the developed world was apparently myopic and insufficient.

Due in part to the events mentioned above, the term "global health" took on a separate, more inclusive meaning that addressed health issues affecting most countries in the world, especially health issues that crossed national borders. In the past, such issues included many infectious diseases such as influenza, tuberculosis, yellow fever, and cholera. More recently, the chronic diseases or conditions such as obesity and diabetes have become prominent global health issues as well. Of course, health conditions that transcend borders have always been part of the study of international health, so this variable seems insufficient for differentiating between the fields of international health and global health.

More recently, some health authorities have chosen to extend the concept of "global health" to include issues that have political or ideological underpinnings. Those underpinnings help describe global health as a field that truly transcends borders, in part by postulating an alternative explanation of disease etiology. The issues of climate change, urbanization, health equity, social injustice, and income disparity all involve political perspectives and controversies revolving around models of science, governance, ethics, and health policy. For some, these and other politically charged subjects distinguish global health from the more restrictive field of international health. For instance, one definition of global health has been described as:

> *…an area for study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide. Global health emphasizes transnational health issues, determinants, and solutions, involves many disciplines within and beyond the health sciences, and promotes interdisciplinary collaborations and is a synthesis of population- based prevention with individual clinical care* [5].

This definition includes concepts such as "determinants of health" and "health equity" that require a public health perspective much different from the older model that identified health-related deficiencies, then sought to address those deficiencies through direct health interventions aimed at the immediate cause. For instance, the immediate cause of malaria is the parasite transmitted to the victim through the bite of certain mosquitoes. A direct intervention might be the destruction of the mosquitoes that serve as the disease vector, resulting in protection from the disease. The global health focus, however, changed to identifying social or health inequities rather than simpler proximal causes of disease. Such language seems based on political and economic perspectives that lead to a definition of global health and an explanation of disease etiology that is much different than the "paternalistic" definition of international health refined during the period of European colonialism. For instance, in the global health model, the interaction between poverty and disease is no longer seen as a mere association or influence, but a cause-effect relationship (hence use of the word "determinant"). Some observers would argue that "determinant" does not mean "cause," though this is the generally accepted meaning of the word. This term is defined by Merriam-Webster

as "an element that identifies or determines the nature of something or fixes or conditions an outcome" [6]. As an example, lack of education is described by some as the cause of mortality rather than just an influential variable [7]. Using the example of malaria, the global health model suggests that better protection for a human population might be gained by addressing the underlying economic and social inequities that allow disease transmission or the most serious disease manifestations to occur. Those underlying inequities might lead to inadequate housing that lacks window screens and doors, insufficient access to health care, lack of appropriate education, or nutritional deficiencies that lead to more serious manifestations of the disease. The term "inequity" in this usage, however, can be problematic in that it implies these disparities are due, not to a deficiency or the lack of resources, but rather to the social state in which one person has more than another: better housing, more access to health care, or better food. By definition, "inequity" in this context implies an unnecessary and unfair situation. In this definition, poor health is due, not solely to a deficiency of resources or to the disease agent causing the symptoms, but also to a disparity in the distribution of those resources. For some health professionals, this focus on inequities and social justice is key to understanding the difference between international health and global health [8].

At the heart of any discussion of global health must be an accepted definition of public health. This broad field of study is the foundation for both international health and global health. A simple definition of public health is *the actions a community takes to ensure that members of that community can remain healthy*. This definition is so broad that it may not be very helpful, so some examples of public health successes may help to understand the definition. The American Centers for Disease Control and Prevention (CDC) identified 10 of the most notable public health achievements of the last century including:

1. vaccination programs that have greatly reduced the incidence of many fatal diseases;
2. fluoridation of drinking water leading to reduction of tooth decay and tooth loss;
3. improved family planning and contraceptive services;
4. reduction in the rate of occupational injuries;
5. safer food and reductions in the rates of food-borne diseases;
6. greater motor vehicle safety;
7. identification of tobacco as a major health threat;
8. improvements in the treatment and prevention of heart disease and stroke;
9. better hygiene, prenatal health care, and nutrition for mothers and babies; and
10. reduction in the rates of infectious diseases through improved access to clean water, improved sanitation and through the development and use of antibiotics [9].

These achievements were the result of multidisciplinary efforts and this is the key to understand what public health must be. At times, this multidisciplinary approach has emphasized collaboration between the health sciences and the social sciences [8]. Global health requires more by greater multidisciplinary collaboration that goes well beyond that of the parent field

of public health to include the work of professionals outside the health sciences including political scientists, civil engineers, religious leaders, and so on.

A final issue that should be addressed in any discussion of global health is the concept of "global health governance." This concept was developed, in part, due to dissatisfaction with international health governance (perhaps, exemplified by the work of the World Health Organization) and reflects a need for collective action to address shared health challenges [1]. Thus, global health governance has been defined as the "rules and procedures by which collective action is taken to achieve agreed goals that protect and promote health within a global context." Such governance has been described as "governance beyond government." In other words, sovereignty of states must be respected. This governance is made possible through a use of non-governmental organizations in collaboration with local governments to address health issues of shared concern, especially as related to the poor, vulnerable, or disadvantaged. Thus, the definition of global health takes on a practical application in a description of how global health issues are addressed and how transnational efforts are governed.

In summary, the definition of global health is still elusive, but there is some consensus that it deals with health issues that transcend borders, that it requires a multidisciplinary response, and that it probably includes a focus on politically and ethically charged global issues such as social justice, urbanization, rapid climate change, and health inequities. That said, the author continues to teach a course titled "International Health" at the university where he is employed. The faculty members chose the name of the course advisedly because they saw the need for students to look at public health issues through perspectives that are different from those of most Americans; that is, from an international perspective independent of American interests. The purpose of the course is to investigate public health issues as they affect others in the world, not as they might affect the local student. Perhaps, this helps to identify the differences between international health and global health even further. International health focuses on public health issues that may not affect the student of public health directly; global health deals with health issues that probably affect everyone, including the student in question. There is room and a need for both perspectives. In conclusion, the concept of global health is still inconsistently defined, yet this has not impeded its use in the health literature nor in practice. Most agree that it is not the same thing as international health, but the lines which divide these two concepts keep moving.

Conflict of interest

The author does not have any conflicts of interest regarding the subject of this chapter or the publication of this book.

Author details

David M. Claborn

Address all correspondence to: davidclaborn@missouristate.edu

Master of Public Health Program, Missouri State University, USA

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Section 2

Culture and Public Health

Chapter 2

Globalization and Health in a Small Town in the Amazon Region

Viviana Mendes Lima, Sandra M.F. Costa and Helena Ribeiro

Additional information is available at the end of the chapter

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Abstract

The chapter describes results of a study conducted in Ponta de Pedras, a small municipality (27,000 inhabitants) in the estuary of the Amazon River on Marajó Island, in the State of Pará. Close to 400 questionnaires were applied to the population to assess the impact of globalization on the municipality. The main revenue of the municipality comes from the export of açaí fruit, which became a global product after being discovered by two Californian surfers in around 1990. The city is three and half hours by boat from a large city, but it is connected to the world by Internet via mobile phones (95% of urban and 79% of rural population have a mobile phone), which is used for social media access, studies, açaí sales, and to buy products. Effects on cultural and eating habits have been observed, as processed foods are replacing fish and açaí among youngsters in the local diet. Hypertension was the main morbidity reported by the interviewees, particularly those living in the rural area. On the other hand, the urban area has poor sanitary infrastructure and public services. The chapter ends by discussing the complex role of globalization in the development of communities and how local governments and health policies could act to balance the effects of globalization on health.

Keywords: globalization, açaí fruit production, eating habits, health, Amazon region, Ponta de Pedras

1. Introduction

Amazon as a biome has a vast and large tropical forest, a diverse and greatly desired ecosystem that is important to the world in an environmental, social, and economic perspective. It attracts the attention of different people with varied exploitation interests. The use of its

natural resources has intensified, especially for export, with few benefits for its socioenvironmental sustainability. Anthropization of the territory and changes in the natural landscape reflect intense rural-urban migratory processes.

The Brazilian Amazon is the largest region in the country with 4 million km^2. It has 12.9 million inhabitants, according to [1], corresponding to 8.2% of the Brazilian population. The end of the twentieth century, at the Amazon frontier, brought important structural and territorial transformations in the economic and social relations resulting from globalization [2]. This phenomenon promoted changes in the Amazon and affected the forest biodiversity [3, 4]. Globalization conveys the ideas of speed and fluidity that are connected to the characteristics of modern global society, defined by [5] as the technical-scientific-informational environment. Globalization is not only the existence of this new system of techniques, but it is also the result of the actions that ensure the emergence of a so-called global market. It is related to a consumer society, a technological society, or capitalist information societies, referred by [6] as the network society.

Considering these aspects, this chapter aims to analyze the production of açaí for the inclusion of the region in the globalization process, in the municipality of Ponta de Pedras, in the Brazilian Amazon, located in Marajó Island, Brazil. This relationship was studied in rural and urban areas, based on three elements: access to consumer goods, changes in eating habits, and population health.

Açaí (*Euterpe oleracea* Mart.) has been increasingly used in national and international cuisine, so it is globally marketed, after it was discovered by two Californian surfers in around 1990. The production of açaí fruit is one of the main elements of the income and consumption of the riverside population of the State of Pará, with heart of palm as a by-product [7]. Also known as açaí-do-Pará, açaí-do-baixo Amazonas, açaí-de-touceira, açaí-de-planta, and true açaí, it has countless uses [8]. Its production is best developed in floodplains, during the rainy periods of the region. The expansion of the açaí economy occurred due to a combination of internal and external factors. This expansion cannot be understood as a result of rural migration and urban growth only, but also due to changes and maintenance of eating habits, taste preferences, and forms of consumption, which occurred together with changes in the symbolic value related to açaí [9].

For the development of this quali-quantitative study, a field data collection methodology was used, with questionnaires applied to the person in charge of the household, 320 in all urban sectors and 68 in the rural area of Ponta de Pedras, following randomized, stratified sampling (approved by the Ethics Committee of the Public Health School of USP, 099377/2015). In the rural area, the communities located along Rio Fortaleza, Rio Jupuba, Rio Marajó-Açu, and Rio São Miguel were selected because of their economic importance in the production and sale of açaí, and because they are close to the urban area. The following information was obtained: socioeconomic profile of the residents, family income, educational level, ownership of consumer goods as electrical and electronic equipment, eating habits and types of food consumed, waste disposal, sanitation habits and infrastructure of households, and health conditions. The field study was conducted between January and July 2016.

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2. Ponta de Pedras: a municipality in the Brazilian Amazon

Ponta de Pedras is part of a group of small cities in the Brazilian Amazon. It is located at latitude 01°23′25″ South and longitude 48°52′16″ West, and it is one of the 143 municipalities of the State of Pará (**Figure 1**). Its site is on Marajó Island, in the estuary region of the Amazon River, 3 h and 30 min by boat from the state capital, Belém. The municipality has an upland (Terra Firme) and a lowland influenced by the Rio Marajó-Açu. The water system connected to this river varies in depth between summer and winter, causing changes in the human dynamics of the municipality, such as fishing and collecting forest products, as well as in the navigation on the river. Several durable and industrialized products are brought from the capital by boat for supplying the local commerce, and, on the opposite direction, the local production is distributed to Belém, such as fish, açaí, heart of palm, among others. The degree of urban/rural mobility is determined by factors that include the distance between the communities and the City Administration and the economic power in the urban area [11].

The municipality had 27,000 inhabitants, 49% of them in the urban area, an annual population growth of 3.35% between 2000 and 2010, and Human Development Index (HDI) of 0.562, lower than the Brazilian index of 0.768 [1]. Regarding the municipal HDI, in 2010, longevity presented a 0.77 index, income 0.558, and education 0.412, the worst component of the local index, indicating a high proportion of children and youth out of school. As discussed by [12], between 1969 and 2010, the small town of Ponta de Pedras expanded physically by more than 100%,

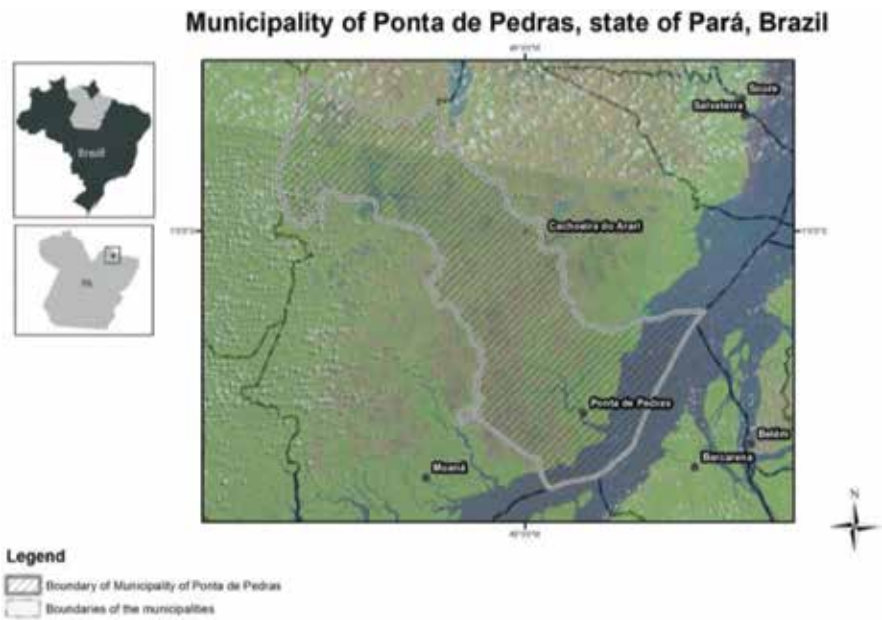

Figure 1. Location of the municipality of Ponta de Pedras. Source: produced by Laboratory for Studies of Cities—UNIVAP [10].

and this growth meant a significant increase of its urban area. The municipality's predominant economic activity is the açaí production and fishing. Poor sanitation and health services are widespread. The urban area of Ponta de Pedras, despite presenting economic growth, does not provide proper services and basic infrastructure to its residents [13]. On the other hand, 99% of urban households have electricity, and in the rural area, it is 90%. The population reported that the Federal Government's "Electricity for All" program, starting in 2009, improved their living conditions and provided access to energy-dependent goods and benefits. Electricity in households already had increased from 32.19% in 1991 to 74.84% in 2010.

More than half of the urban population (61%) has a family average income of 1–3 minimum wages (US$ 250), and among the rural population, 25% receive up to one minimum wage. Minimum wage is paid as salary or retirement to Brazilian population, and it is established annually by a federal decree. At the time of the fieldwork, it was around 250 US American dollars.

Higher income in the urban area is due to the possibility of developing autonomous activities and small services, such as the sale of açaí at home. Regarding their income, the interviewees reported that the benefits received from the government (such as family minimum allowance, unemployment insurance to fishermen and retirement) are important in the domestic budget to cover family expenses, and contribute to the local economy and access to consumer goods, such as mobile phones and household appliances, internet services, etc. In Ponta de Pedras, 55% of the inhabitants in the urban area and 51% in the rural area receive the family minimum allowance. In the rural area, the unemployment insurance to fishermen is the most important benefit, received by 76% of the interviewees. In addition, the high number of workers in açaí extraction activity in rural areas indicates it is the main source of local income. Of the total number of interviewees from the rural area, 8% have the family allowance as their sole source of income as they do not have any formal employment or other income. In the urban area, 18% of the interviewed families do not have any income, and in the rural area, 6% of interviewees reported no benefit and no source of income.

Lack of sufficient income has a direct impact on family health determinants, including food availability. On the other hand, this reality has a smaller impact on rural population, as interviewees reported they can plant and have fruits from the forest such as açaí, besides fishing, which guarantees healthier sources of calories.

Regarding the educational level of the interviewed population, 14% are illiterate in the urban area, and 13% in the rural area. Only 22% of the urban interviewees concluded high school, and in rural communities, only 4% have this degree. Low educational levels have a negative impact on finding a good job, according to the interviewees, especially for young people.

3. Açaí: from local consumption to global production

The Amazon region, or Legal Amazon, has always played an important role in the extraction economy. The region went through several economic cycles, including rubber, fruits and plants from the inland, and nowadays the *black gold* referring to açaí. This new economic

moment has also resulted in new land and social conflicts, inserting the Amazon in the global agenda. In Brazil, the State of Pará is the largest producer of açaí [14].

Açaí has become a key cultural symbol of the region, valued for the quality of its fresh juice, heart of palm, its multiple uses, and unique esthetic beauty of the plant that is sold for gardens of all social classes [9]. Besides manioc, açaí is a staple food and a vital source of calories for the local population. The market of açaí export to the United States, Japan, and other countries[1], in 2012, amounted to more than US$ 17 million. The trend is to increased exports due to an investment in açaí handling and production, processing of the fruit, and expansion of exports to other countries [8, 15].

As açaí won the preference of consumers abroad, it also became a global market product, which inserted Ponta de Pedras, a small municipality in the Amazon with excessive production, in the global market. However, the exported amount is still below its full potential. Globalization has reduced the distance between markets [16].

With the internationalization of açaí fruit, its production and distribution network, particularly of the State of Pará, invested in marketing, targeting the external market. With the advent of technologies and social media, the product has received even more attention, leading to new consumers out of Pará, leveraging this global consumer market.

When a product is inserted in the global market, its condition, entity, or local identity is extended beyond national boundaries and becomes global [17]. The local production of açaí, when winning the international market, is submitted to this process beyond borders. However, the commercial transaction of this extractive product has generated economic and ecological benefits to the local population, contributing to the economic sustainability of many riverside families. In addition, the workers of the açaí production chain, and other extractive products, adopted sustainable practices for the extraction and conservation of açaí palm trees [9]. In this new economic cycle of the fruit, large commercial cities, and small towns in Amazon, like Ponta de Pedras, were benefitted.

The globalization process allows insertions from local to global level; however, it requires dynamism that, often, does not correspond to the local reality. It is related to environmental, sociocultural and sometimes economic deteriorations that directly or indirectly impact the population, especially on the riverside [8]. On the other hand, this space transformation in the Amazon contributes to the strengthening of urban networks [18].

Açaí started to be sold in the state of Pará, at supermarkets, gyms, and fast food chain stores, in order to fulfill new market niches and cover consumers with higher purchasing power [19]. The fruit exploitation is conducted in native açaí plantations, which present low productivity, especially between harvests [20]. Because of this problem, many families adopt deforestation practices to produce subsistence crops, turning the environmental problems in the region worse. Social and economic connections involved in the açaí trading have changed the fruit

[1]Abu Dhabi, Germany, Angola, Argentina, Australia, Belgium, Canada, China, South Korea, Denmark, United Arab Emirates, Slovakia, Estonia, France, Holland, England, Israel, Norway, New Zealand, Peru, Puerto Rico, Portugal, Czech Republic, Russia, Singapore, Sweden, Switzerland, Taiwan, and Uruguay [8].

production practices and land use, and intensified the relations between rural and urban families and communities living in açaí production municipalities like Ponta de Pedras.

The production of açaí is considered an extractive activity, with exemption from federal [14] and Pará state taxes.

3.1. Açaí in Ponta de Pedras: from local staple food to global market

Ponta de Pedras is an important producer of açaí, which is mainly marketed in Belém, and then exported to other regions of Brazil and abroad. Ponta de Pedras harvests 12% of the total amount of açaí produced in Brazil [18].

Açaí extraction can be considered a sustainable activity, fulfilling the regulations issued by the United Nations for Sustainable Development for a global sustainable economy [21]. In Ponta de Pedras, the açaí extraction is part of a local sustainable economy [22].

For many riverside families, this production represents a low-cost way to survive. However, in addition to açaí production, they fish and extract other fruits and heart of palm, with a stable family economy during the açaí crop cultivation. The population has a very close relation with the place where it is inserted, and the main economic activity of both urban and rural inhabitants of the municipality is related to the production of açaí [23].

Figure 2 shows pictures of the açaí fruit production chain, from the açaí trees to the end product ready to be shipped and sold in *paneiros* (woven containers).

The type of açaí produced on Marajó Island is widely accepted in the market because of its quality due to the climate and to the physical characteristics of the soil [24]. With globalization, the small producers of açaí have changed the rhythm of production to serve an increasingly growing and demanding market. By the end of the twentieth century, açaí was considered a staple food product of the local population, consumed with manioc flour, fish, and shrimp [25].

According to reports obtained in the field, workers who act as açaí harvesters receive a low remuneration (R$ 5.00—five reais or one and a half dollars) per *paneiro* (not full) or a large can, which corresponds to around 18 to 20 kg. However, açaí is the main source of income for many families, who complement their income with the sale of fish, shrimp, pig, and poultry and/or government allowance programs. Another study about açaí conducted in Ponta de Pedras [18] demonstrated that the fruit has changed the reality of several families, who manage to survive between harvests with savings due to the price the product reaches in the market. This way, açaí moves the formal and informal economy of the municipality.

According to the field survey, 92% of the interviewees who work with açaí do not have a labor record booklet in the urban area and 100% in the rural area. Census data [1] also confirm these numbers: 23% of the population living in Ponta de Pedras had a job but without a formal contract, and 52% were self-employed, which characterizes widespread informal employment.

Açaí inserted Ponta de Pedras in the economic and gastronomic scenarios at national and global levels [17], placing the municipality in the global scenario. Ponta de Pedras is in the

Figure 2. Açaí production in the municipality of Ponta de Pedras (a), sale of açaí by canoe in the community of Fortaleza (b), and Açaí open market in Ponta de Pedras (c and d). Source: collection of the Laboratory for Study of Cities—UNIVAP [10].

process of developing other economic sectors, with potential for tourism activities. However, açaí remains the most important item that advertises the municipality, as it is the largest producer of the fruit.

4. Globalization, consumption goods, and health in a local perspective

This study attempted to analyze whether this insertion in the global economy, due to açaí exports, has impacted the quality of life and health of the population of Ponta de Pedras. Globalization of healthcare is a complex theme, due to its intricate and varied aspects, but an intriguing topic to be studied. Historically, international health relations have helped find the cure of many diseases and develop technologies to fight or mitigate epidemics.

The perspective of globalization in healthcare has strong consequences on demography, production, consumption, and the environment and reinforces the need for new approaches that consider the relations between local and global/universal aspects [26].

Brazil might be considered a predatory state, due to the over-exploitation of natural resources for more than three centuries, with little care for the environment: gold, iron, various agricultural products, nonrenewable natural resources and, in particular, the Amazon rainforest, with its biodiversity that has been highly valued until the present times [6].

Health in its full conception inevitably includes the economic development of countries [27]. The future of health depends more and more on new processes related to the advancement of globalization.

A recent report issued by the World Health Organization (WHO) on chronic diseases indicates that cancer, diabetes, and cardiovascular disease are the main causes of death in the world [28]. Of the 38 million lives lost in 2012 by chronic diseases, 16 million, or 42% were premature and preventable (an increase of 14.6 million deaths over 2000), and 80% of these deaths worldwide occur in low- and middle-income countries [28].

The cities of the Amazon region, due to their geographic and population characteristics, and different aspects related to the development of public policies, are sensitive to environmental problems, which reflect in the quality of life and health of the population [29].

In this sense, studying the urban dynamics in the Amazon is critical to understand the health-disease complexity in this vast territory [30]. The major challenge lies in the different spheres of power and should involve the articulation of a coherent model of development, which considers natural, social, economic, political, and cultural processes in order to minimize negative impacts on the population, especially to more vulnerable groups.

Thus, the globalization process imposes complex consequences on the least developed countries, and which are reflected locally.

4.1. Globalization and access to consumption goods

Riverside families gained visibility and economic resources due to their acai production, but the resources did not bring many improvements in their living conditions. For the residents of Ponta de Pedras who work with açaí, in plantation, extraction or sale, the fruit has brought mainly increased purchasing power and access to consumer goods and communication technology.

This study showed that the globalization process in which Ponta de Pedras is situated was largely driven by changes in açaí trade at regional, national, and global levels. The investments made were destined mainly to provide internet access to the municipality and it was critical for its insertion in the commercial scenario. In an attempt to understand how this municipality is included in the context of globalization, the interviewees were asked about their access to technologies, especially telephones, social media, and consumer goods. This study found that the connection between the small community and globalization through the açaí economy, combined with the availability of electricity and the operation of communication services, has allowed the access to an infrastructure of communication such as the Wi-Fi and LAN centers, ensuring new technological spaces. In 2016, Ponta das Pedras became the first digital city in Marajó island, as optic fiber wire for high-speed internet was installed in public buildings and free Wi-Fi area was inaugurated in the main public square.

The search for better living conditions, for many interviewees (49%), led to the migration from rural to urban areas. The reasons for this migration are varied: access to health services for 75% of the interviewees who were seeking medical specialists; access to a variety of stores; and access to communication services, particularly mobile telephony and internet.

Regarding the access to technology, it provided new options to modernize the urban activities. Most interviewees reported they had a mobile phone because it was the easiest way of communication: 91% of them from the urban area and 79% from the rural area. In the rural area, the distance from the urban center of Ponta de Pedras reduces the reception quality, which is a constant complaint of the residents.

Even among the population that earns less than one minimum wage, more than 40% buy high-cost mobile phones of famous brands. Some interviewees reported they buy high-cost mobiles to access apps that allow them to connect to Facebook®, WhatsApp®, internet, more advanced games, among other reasons.

Half of the respondents (50%) answered they use their mobile phone to access internet because it is more practical and economically viable, besides allowing a better control of expenses with mobile credits; and some of them said they partially used their social benefits for this purpose. Young people use the cell phones more frequently to access the internet, since the elderly, due to their low educational level and poor familiarity with electronic devices, use fixed telephones to communicate. In rural areas, 81% of respondents said they did not know how to handle the device or access the internet, which is the responsibility of another family member, usually their children or grandchildren. In the urban area, 51% of the respondents answered they did not know how to access the internet via mobile phone.

The internet is mainly used by the interviewees and their families to study (78%) and access social media in the urban area, and in smaller proportions in the rural area. Some interviewees reported it as an important means of communication because it enabled them to hear from family members and solve some health-related issues, such as setting medical appointments and exams. For a small portion of rural producers (3%), a mobile phone allows them to call açaí dealers to set the product price for the current harvest. They explained it helps them figure out how much they could profit from the harvest, since *paneiro* cost varies greatly. Small producers use mobile phones via satellite to check the price of the açaí *paneiro*, a very common practice in the globalized world, especially used by large companies that use technological benefits. It places global and local contexts closer, thus reducing the distance and access between people. The circulation, mediated by technology, is accelerated, in particular by the new forms of telecommunication via computers (networks) that constitute the material basis of the "space of flows of financial capital" [31].

However, this technological universe in Ponta de Pedras is a new world, something like a technological revolution in environment of the Amazon region, due to the conditions of access from long distances, or the cost of mobile phones, which for many residents is high. Despite that, 70% of the rural interviewees answered they had a mobile phone at home, and in the urban area 80% answered they had two or more mobile phones (up to 6) at home.

4.2. Eating habits

Regarding the eating habits and types of food the interviewees consumed, this study found these aspects also had the influence of globalization.

Changes in the eating habits of the population in Amazon are associated with strong marketing strategies that large international food companies develop in the region to attract new consumers. In this study, despite the low percentage of interviewees who reported changes in their eating habits, the introduction of processed and ultraprocessed products in their diet was observed, especially among the young population, who consumes a higher variety of processed foods [32]. In addition, the heads of families have the perception that the processed food consumed by young people is not good for health and mentioned their worry about increased number of diabetic and hypertensive people in the municipality. This perception is reinforced by official data about diabetes and hypertension [33]: there were 3 cases of diabetes and 43 cases of hypertension in 2007 at the municipality of Ponta de Pedras. In 2011, 16 cases of diabetes and 285 cases of hypertension were reported, demonstrating the increase.

Industrialized food products are sold in stores and represent a food transition, which has affected the health standards of the population. Answers on eating habits of the families indicated the consumption of chicken, pork, beef, and sausage, despite the population's preference for fish and flour. The weekly consumption frequency of the inhabitants is as follows: sausage in the rural area, 25 and 15% in the urban area and chicken once a week, 31% of rural residents and 38% of urban residents.

Table 1 shows the processed foods purchased every month, in proportion to the number of urban and rural interviewees. Some foods, which are not part of the traditional Amazon diet or manufactured with local products, are bought by a high number of families. The lack of a refrigerator could explain the purchase of canned goods and noodles, but yogurt bought by more than half the rural families, and 66% of urban families, weakens this argument.

Type of food	Urban population in %	Rural population in %
Pasta/noodles	85.9	94.1
Yogurt	65.9	55.9
Soft drinks	58.8	61.8
Canned/conserved food	49.4	60.3
Cereals/grains	44.4	38.2
Candies/sweets	35.6	25.0
Ketchup/mayonnaise/mustard	28.1	10.3
Snacks	24.1	11.8

Source: field study conducted by the authors.

Table 1. Processed and industrialized foods bought monthly by the population.

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At the urban area, 6% of interviewees at 19% in rural communities reported that their children and grandchildren had exchanged fish and açaí for other foods. This did not happen with the elderly, because these are traditional staple foods of local population.

4.3. Health and globalization in a small town in the Amazon

The North region of Brazil has a history of low health indicators. Health has to be seen today as a global issue, and healthcare globalization is a positive aspect that should be developed in a clear and well-planned manner [34]. At the current stage of globalization, the policies that promote health [28] have not brought considerable improvements for the population of Marajó Island, especially low-income population. Globalization is consistently consolidated as it pulls down the relationship between territory and its natural products and the community. Then, characteristics of the urban way of life, such as diseases, also appear in rural areas, resulting from the consumption of industrialized and globalized products, pressure for increased productivity on workers, and the appeal to the consumption of goods and merchandise.

The dynamics of small cities show limited development due to several factors, such as low educational level, scarce resources, difficult communication and transportation, and lack of sanitation infrastructure, which affect health conditions.

This research used the questionnaires applied to residents to identify health problems. One can observe that their perceptions on their health problems are more focused on new health issues than on diseases that historically are part of their everyday life.

The interviewees did not frequently report diseases, such as diarrhea and malaria, often cited in studies analyzing these riverside environments and registered in official data. Infant mortality in the municipality is very high, 30.2 per 10,000 newborn, placing it in the 4199 place among 5570 Brazilian municipalities. Also, there were a tax of 9.2/1000 hospital admissions due to diarrhea, in 2014 [1]. The Information System on Social Indicators of the State of Pará reported 924 hospital admissions in 2010, in Ponta de Pedras, of those 199 (18.3%) were due to infectious and parasitic diseases. These represent the second cause of internment after baby deliveries (231 hospital admissions).

In the interviews, 17% of people from the urban area and 21% from the rural area reported physician diagnosis of hypertension. High cholesterol levels were reported by 8% of urban interviewees and 7% of rural; and diabetes was reported by 6% of urban interviewees and 4% of rural ones. In fact, Information System from Ministry of Health indicates a large increase in the number of hospital admissions due to diabetes mellitus in Ponta de Pedras, in the last 10 years. There was 1 admission in 2009 due to this disease, 2 admissions in 2011, 5 in 2012, 6 in 2013, 15 in 2014, 22 in 2015, 25 in 2016, and 25 in 2017.

During data collection, some interviewees complained about the lack of physician and medicines for the treatment of diseases such as hypertension, diabetes, and high cholesterol levels, especially in the rural area, where the access to health services is more difficult. They reported

that the Family Health Program (FHP) from the government does not always provide medication, and because of their low income, they cannot buy pharmaceutical products.

Chronic noncommunicable diseases (CNCDs) account for 58.5% of all deaths worldwide and 45.9% of the global burden of disease [28]. In Brazil, these figures have increased more than three times since the 1990s. Chronic diseases have played an important role in the epidemiological profile of populations, especially those living in urban areas; the study also reports different determinants in this type of anthropic space organization [35].

Despite the large water supply in the Legal Amazon, official data show that the worst regionally evaluated indicators belongs to this region: 56% of the households do not have water supply from the public system; of the total water volume distributed by the public system, 32.5% had no treatment, and 92% of the municipalities in the region had no sewage collection system [1]. In Ponta de Pedras, many residents, because they need these essential services, had to improvise water access and storage systems.

Most interviewees from the urban area (75%) reported access to water supplied by the Pará State Sanitation Company (COSANPA), but that the water is not treated. Less than 10% of the interviewees reported access to water from a neighbor or an artisanal well. The situation is different in the rural area, where 90% use river water and 10% store in gallons, water that comes from the urban area. In the interviews, residents complained about the constant lack of water, for up to 3 or 4 days a week, which explains using the neighbor's water. Many residents store water inadequately at home, often creating an environment that favors the proliferation of vectors such as *Aedes aegypti*, the mosquito that transmits dengue virus. The environment presents precarious conditions reported by the interviewees, with stagnant water and garbage. The perception of water quality by the population is ambiguous; although they find impurity and recognize the scarcity of water and sanitation, they see the river and the forest as natural resources essential for them.

In spite of the belief that water is of good quality, 76% report water treatment before consumption, as they do not trust its origin. In the rural area, 67% treat it before cooking and drinking. However, rural residents have the perception that the "river is clean," as they eat fishes and shrimps from this environment. Before using the water, some urban residents reported that they "boil" it (3%), filter it (16%), or use sodium hypochlorite (43%); in the rural area, 72% answered they use sodium hypochlorite distributed by the Municipal Health Department. Considering the above, their low reference to waterborne diseases and diseases transmitted by vectors is not consistent with this unhealthy situation. More than 45% of urban respondents and 65% of rural respondents did not know the predisposing factors to their diseases.

When asked about disease concerns, rural residents answered they had symptoms of a viral disease due to poor water quality. However, only two families were submitted to laboratory exams and found a parasitic disease (the resident did not know how to describe the disease). In Ponta de Pedras, waterborne diseases, most reported by residents, were viral (12% in rural and urban areas) and diarrhea (5% in the urban area and 3% in the rural area). This study in Ponta de Pedras highlighted the lack of infrastructure, such as piped water and sewage system, and that its availability does not cover all sections of urban and rural areas. In the urban area, the neighborhoods were occupied in diverse periods, while public investments in infrastructure were made in different stages and paces.

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Regarding sewage discharge, the most common practice is discharge in a watercourse, compromising the water quality of the river and its source. In the urban area, 43% of the residents adopt this practice, and in the rural area, 82.6% justified by the absence of a sewage system, except for the cesspools. Septic tanks are the second option of sewage disposal to 32% of urban residents, especially for those living in floodless areas.

Sewage discharged in a stream eventually goes to the river, where the residents wash clothes, fish, where children take a bath, and whose water is used in home cleaning and other daily activities. Regarding waste disposal, 21% of urban residents burn the waste, claiming that the city does not collect solid residues as it should. In the rural area, burning residues is conducted by 98% of the respondents, who claim that burning is better than throwing them in the river.

This study found that the population of Ponta de Pedras is not satisfied with the services provided by the municipality, including the cleaning and other essential services such as education and health. Health services are top complaints, reported by 67% of the interviewees as an unsatisfactory service.

In Ponta de Pedras, the problems are perceptive in the landscape. **Figure 3a–d** shows how the environment and health are intrinsically related, affecting the quality of life of the population.

Figure 3. Urban area that represents an environmental and sanitary risk to the residents. (a) Stilt houses and precarious wooden bridge to access the houses, (b) residence with wooden bridge, (c) and d) precarious access to water and environmental and health vulnerability. Source: collection of the Laboratory for Studies of Cities—UNIVAP [10].

The environment plays a fundamental role associated with health conditions, as environmental factors can cause ecological imbalance and, consequently, the proliferation of pests, which can be vectors of diseases [34]. Wooden houses are characteristic in the Amazon and are mostly built on stilts to avoid river flooding, for being economically viable, and to provide some thermal comfort to residents in local climatic conditions. Based on data collected, the epidemiological profiles of the region and the municipality are marked by overlapping of diseases resulting from local living conditions and low access to prevention and control measures, in addition to poor health services.

5. Final remarks

Institutions such as the World Health Organization (WHO) and the Pan American Health Organization (PAHO) [36, 37], ministries and health departments are responsible for planning, monitoring, inspecting, and promoting actions to promote health in the world. In the last five decades, several important global events have been held in relation to global public policies, especially those that reinforce health promotion.

Intersectoral dialog has become increasingly necessary between institutions and countries. Advances in technology and science allow a better analysis and understanding of environmental interventions in order to mitigate damages caused to exposed populations. Globalization causes strong impact on economic, social, political and cultural areas, and, at the same time, on spatial organization that reflects on health conditions. The scales of the impact caused by globalization are differentiated around the world and very particular in realities like the municipality of Ponta de Pedras.

Ponta de Pedras is one of the largest açaí producers in Brazil, but the fruit trade has brought only few benefits to the population, particularly to small and medium producers and traders of the fruit, even with the overall projection of açaí consumption. This study, although lacking comparative temporal data, points to the direction that the global açaí market might have interfered in the health conditions of the residents. Both perception of inhabitants and some available official data point that noncommunicable chronic diseases are becoming more important health issues among the residents. On the other hand, infectious diseases and high infant mortality persist, very much related to the poor sanitary infrastructure and public services, low educational level, and poverty.

In spite of efforts of the federal government in providing electricity, public internet access, and minimum allowance for underprivileged population, local governments find it difficult to implement health policies and sanitation systems, and to receive and use resources for a number of reasons of administrative, technological, educational nature, and distance from regional centers that make important decisions. Thus, although some economic resources and consumer goods are more accessible to a portion of the population, most of the residents remain vulnerable to social and environmental health determinants.

Deficiencies in the form of poverty exist at all territorial scales—regional, national, and global—and increasingly affect remote municipalities, such as Ponta de Pedras, and directly influence health, a scenario that is commonly seen in many other Brazilian municipalities.

Public policies must consider this ongoing process in order to extend the social benefits to the vast Amazon region. Health policies could also act to balance the effects of globalization on health.

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Conflict of interest

The authors have no conflict of interests to declare.

Author details

Viviana Mendes Lima[1]*, Sandra M.F. Costa[2] and Helena Ribeiro[3]

*Address all correspondence to: geomendes@usp.br

1 Department of Environmental Health, School of Public Health, University of São Paulo, São Paulo, SP, Brazil

2 Laboratory for Studies of Cities, University of Vale do Paraiba, São José dos Campos, SP, Brazil

3 Department of Environmental Health, Faculty of Public Health, University of São Paulo, São Paulo, SP, Brazil

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Chapter 3

Cultural Sensitivities and Health

Chuka C. Agunwa and Emmanuel I. Obi

Additional information is available at the end of the chapter

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Abstract

Culture is that complex whole which includes knowledge, belief, art, morals, law, custom, and other capabilities acquired by man as a member of the society. Its components include knowledge, beliefs, norms, techniques, folkways, mores, laws, values, material culture, and universal culture. Health programs and interventions are more effective when they are "culturally appropriate" for the populations they serve. Each medical encounter provides the opportunity for the interface of several different cultures: the culture of the patient, the culture of the physician, and the culture of medicine. Peripheral, evidential, linguistic, constituent involving, and sociocultural strategies enable the health worker practice culturally sensitive healthcare delivery. Cultural targeting and cultural tailoring are applied to groups and individuals, respectively, by taking their peculiarities into account in making health care available to them. A combination of both approaches is recommended for optimal health outcomes. Cultural competency is the answer to the need for previously lacking cultural consideration in planning and delivering care. It enables the health worker overcome organizational and clinical barriers which continually impede efficient and effective healthcare delivery.

Keywords: culture, healthcare delivery, beliefs, targeting, cultural sensitivity

1. Introduction

What is culture? It is a complex term whose concept varies greatly, carrying different meanings depending on the social context and population in which it is applied. However, despite its more than 160 definitions, the definition by Edward Taylor in 1871 has enjoyed the most widespread global acceptability.

> *"Culture is that complex whole which includes knowledge, belief, art, morals, law, custom and other capabilities acquired by man as a member of the society."* [1]

Cultural anthropologist Kenneth Guest provided an effective and useful framework of culture when he stated "culture is a system of knowledge, beliefs, patterns of behavior, artifacts, and institutions that are created, learned, and shared by a group of people" [2].

Culture comprises generally acceptable ways of doing things common to a people which is transmitted from generation to generation. It is a people's way of life, an embodiment of their identity.

2. Components of culture

2.1. Knowledge

The culture of a people includes a tremendous amount of their knowledge about their physical and social environment. This comprises a vast collection of ideas, ideologies, philosophy, science, and technology which they utilize in the attempt to understand the world they live in. These are usually of cognitive origin and basically include knowledge of how to obtain food, what to eat, how to provide shelter, recognize and treat diseases, protect the community, etc. [3].

2.2. Beliefs

Beliefs are generally acceptable knowledge that can neither be substantiated nor proven to be false. In various cultures, they constitute important aspects of human living.

2.3. Norms

A norm is a value or standard of behavior commonly found in a given group or society. The term is derived from the word "normal." There are four major types of social norms.

2.4. Techniques

These are norms that guide the methods of carrying out tasks when technical efficiency is of utmost concern. For example, in transportation, horses can be used.

2.5. Folkways

These demonstrate the ways of life of people which place a priority on moral ethics. For example, people are expected to greet those who are older than them, in some African societies, the kola nut is shared and eaten before any important ceremony. However, an infringement of these regulations does not necessarily imply any serious threat to society and therefore does not attract severe penalties.

2.6. Mores

Mores are also ethical regulations but unlike folkways they have significant effects on the survival of the group. Contraventions of mores therefore attract severe penalties. These infringements may come in form of incest, theft, murder, desecration of objects which carry spiritual significance such as items of worship.

2.7. Laws

These are norms which are formally coded and enforced by recognized authorities. They tend to include societal mores. Laws cut across all norms, and deviations from them threaten the corporate existence of the society. Thus, society empowers law enforcement agencies who act for common good.

2.8. Values

These are important elements of the culture of a society which determines what principles it considers as essential to its well-being and survival. It will usually include important ideals such as freedom, justice, the rule of law, due process, and ceremonies. These ideals form a value system which guides societal life.

2.9. Material life

This is the visible, tangible component of a society's way of life. Examples include buildings, dressing, art, books, etc.

2.10. Universal culture

There are aspects of culture which have been found to be acceptable to all human societies no matter their origin or location. These components are thus universally acceptable across the world. Some examples include the recognition of gender, age groups in form of childhood, adulthood, and old age [3].

3. Culture and health

It is a proven fact that health programs and interventions are more effective when they are "culturally appropriate" for the populations they serve. To effectively and efficiently provide medical care to patients, the impact that culture has on health care must be understood and taken into consideration. In practice, however, the strategies used to achieve cultural appropriateness vary widely [4].

To provide programs and materials that are culturally appropriate, healthcare providers must be able to

- identify and describe cultures and/or subcultures within a given population;
- understand how each aspect of their culture relates to health behavior, and most importantly;
- apply this knowledge in the conceptualization, design, planning, and implementation of activities which bring health care to the people.

Each medical encounter provides the opportunity for the interface of several different cultures: the culture of the patient, the culture of the healthcare provider (e.g., the physician),

and the culture of medicine as a discipline. The success of this interaction influences adherence to medical regimens, patient satisfaction, healthcare utilization, and ultimately health outcomes [5].

The World Health Organization (WHO) global strategy on people-centered and integrated health services is a call for a fundamental paradigm shift in the way health services are funded, managed, and delivered [6]. Behind this new approach is a vision of a time when the needs, personal preferences, and safety of target populations are taken into consideration in health program planning. It is also based on the conviction that this is possible while still maintaining the timeliness, quality, effectiveness, and comprehensive content of these services.

It is sad to note that in many instances, culture is not properly evaluated. There seems to be instead a lot of assumptions made about what the culture of a group of interest is. A typical example is the mistake of assuming that all Asians have a single uniform culture or that all members of the Zulu tribe have identical belief systems. Instead that racial entity comprises several cultural subgroups and any one individual may belong to one, none, or several.

If indeed one could categorize all members of a given population into groups that had practically all aspects of their culture in common, one would have gained the advantage of carving out groups with very high levels of homogeneity. However, the process would produce so many groups, some with scanty numbers, that it would no longer be feasible to address the population any more. Which of the myriad of groups should then become the focus?

At the opposite extreme, culture would be assumed and overgeneralized based on more easily identifiable variables such as race [4]. Neither of these approaches is ideal.

Although it is true that certain cultural characteristics may cluster within a given racial or ethnic group, it is at least equally true that substantial differences exist between individuals and subgroups within these populations [7–10]. Somewhere between these two extremes, we might settle for a slightly deeper, albeit imperfect, understanding of culture that is practical enough to be easily applied yet still potent enough to enhance healthcare delivery efforts.

Many authors have previously described strategies to make health promotion programs and materials more culturally appropriate for target populations and these have been divided into five main categories: peripheral, evidential, linguistic, constituent-involving, and sociocultural [4]. It should be emphasized that these categories are for organizational clarity only and are not necessarily mutually exclusive. Besides, it is presently common, and advisable, for practitioners to use strategies from multiple categories when a health program is to be planned and implemented. These approaches are explained below.

Peripheral strategies ensure that health programs are culturally appropriate by presenting them based on what the perceived interests of the target group are. This is achieved by matching materials to "surface" characteristics of a target population—as is done using peripheral approaches—the group's receptivity to and acceptance of information and services can be enhanced [11]. For example, materials used for health education can carry national colors or be made from traditionally familiar materials such as "Kente" in Ghana or "Ankara" in Nigeria.

Evidential strategies enable a group to identify with a health problem by demonstrating how it affects that group. Most of the time, this is achieved using as proof, information obtained from within the population.

This is put into action, for example, when advocacy for provision of emergency obstetric care facilities within public health centers is made using the following message: "For every 100,000 Nigerian women who get pregnant, 814 will die between pregnancy and 6 weeks after delivery [12]. That is 10% of the global maternal mortality burden. Not only did the country not achieve Goal-5 of the Millennium Development Goals that sought to reduce maternal mortality ratio by 75% by 2015, but it also essentially witnessed a substantial increase in maternal deaths [13]. These women can be saved if the facilities and people who can save them are present in the health centers."

Linguistic strategies take the common language of the target group into consideration when messages are being composed and disseminated. It is because of the key role language plays in engaging communities that authorities such as Rogler have referred to it as "the lowest common denominator of cultural sensitivity" [14].

Constituent-involving strategies refer to those which are based on the personal experiences of individuals selected from within the group. Adhering to this approach will involve ensuring a high level of participation by community members in the intended program. This enables it to leverage on their "stories" and endues the program with a lot of familiarity from its audience's perspective. [15, 16].

Sociocultural strategies discuss health-related issues in the context of broader social and/or cultural values and characteristics of the intended target group. It is imperative that this kind of program should be based on a deep understanding of the culture of the people. One should appreciate not just what their cultural practices are but why they behave the way they do. This knowledge makes proper prioritization of activities possible. If, for example, economic wealth is highly regarded in a particular community, it becomes important to study wealth creation opportunities which exist and use them as vehicles of engagement with the target population. Alternatively, the same planners might seek to develop a new program that builds on the population's religious values in a way that is meaningful to that group [4].

4. Cultural targeting and cultural tailoring

4.1. Cultural targeting

Cultural targeting is a term that has been given multiple definitions by various authorities. It has been defined as "the use of a **single intervention approach** for a defined population subgroup that takes into account **characteristics shared by the subgroup's members** [17]." Others have defined it as part of a larger process of audience segmentation in which **appropriate channels for reaching a given group** are identified [18], while another school of thought defines it as "a **single intervention approach** for a defined population subgroup that takes

into account characteristics shared by the subgroup's members" [19]. The concept is based on the assumption that the group has enough characteristics in common to make a single approach effective. In reality, this is not always the case.

4.2. Cultural tailoring

Cultural tailoring, on the other hand, is any combination of information or change strategies intended to reach **specific individuals** based on characteristics that are unique to them related to the outcome of interest, and have been **derived from an individual assessment.**

Historically, only a few health promotion programs made serious attempts to develop culturally appropriate strategies to meet the needs of target populations. But with increasing evidence that health promotion programs and materials will be more effective when cultural factors are taken into consideration health service managers seem to be gradually changing their approach. Recently, most interventions have been based on assumptions of culture. While this may be an improvement of the past, much more precision in culture interpretation and description is required for better outcomes [20].

5. Cultural targeting vs. cultural tailoring: striking a balance

Questions have been raised as to whether it is logical to expect a consideration of what is common to a group while still laying emphasis on individual peculiarities. In fact, some authorities have referred to the idea as a paradox [4]. In practice, it is probably unnecessary to expect that one will have to choose between cultural tailoring and cultural targeting when designing and delivering a health service. Instead, it is more important to carefully decide to what extent both approaches need to be combined in order to get the most benefit each offers. There will be situations when the health needs within a target population are so similar that identifying subgroups becomes difficult. In such situations, health tailoring loses its necessity, while targeting becomes the more important approach.

A basic understanding that must be borne in mind is that while a group may have certain characteristics in common (beliefs, values, attitudes, etc.), individuals within the group have imbibed these ideas to different extents, a few not at all. A typical example is the widespread belief in God in African societies.

Therefore, strategies for achieving cultural appropriateness should match the nature of the problem being addressed. The World Health Organization's Sustainable Development Goal Number 10 which seeks to eliminate health disparities can only be achieved by programs which have been adapted based on cultural considerations. This way they will succeed where other programs have failed.

Previous research abounds to prove that minority groups within populations are at a much higher risk of suffering from adverse health conditions such as cardiovascular disease, cancer, etc. While the epidemiology of these conditions indicates that several factors are at play, sociocultural factors have been found to exert a very strong influence on the occurrence of

these diseases. Many indices of poor health situations such as socioeconomic strata, level of education, job-related hazards, and environmental pollution have been found to be more prevalent among minority groups [21, 22]. These poorly represented groups have also been found in greater numbers among the uninsured than among people with insurance. They have higher rates of emergency department use and avoidable hospitalizations, later-stage diagnosis of cancer, and the inability to obtain prescription medications [23, 24].

"Unequal treatment: confronting racial/ethnic disparities in health care," a report by the Institute of Medicine in 2002 identified more than 175 studies which demonstrated the link between minority groups and several disease conditions. These associations were observed even after the effect of possible confounders such as age, disease stage, socioeconomic status, and treatment facility was eliminated [25].

Furthermore, this groundbreaking research exposed factors which had been initially overlooked as playing important roles in the observed disparities between minority groups and the rest of the population. These included health beliefs, values, personal preferences, ability to identify clinical features of disease, ability to communicate effectively with health workers, level of adherence to preventive measures, and health outcome expectations among others. It is believed that all these factors influence health outcomes via their effect on the way the patient interacts with the health system, whether it be the way services are designed or the people who deliver them [26–28].

6. Cultural competence

As the abovementioned evidence accumulated over the years, solutions in the form of "cultural competence" in health care have been prescribed. This refers to a situation where the importance of culture and cultural disparities is taken into consideration and where the design of health programs and services addresses the peculiar cultural needs of a target population. As a result, understanding and addressing the "social context" has emerged as a critical component of cultural competence [26].

A culturally competent healthcare agency, program, or individual provider can function effectively and appropriately in healthcare delivery to culturally diverse individuals. It also involves understanding, appreciation, and respect for cultural differences and similarities within, among, and between culturally diverse populations. To be culturally competent in healthcare delivery, the health professional needs to be sensitive to the differences between groups, to the differences in outward behavior, and also to the attitudes and meanings attached to emotionally related health issues like depression, pain, and disability [29].

The extent to which a society perceives health information or medication as being relevant to them has a profound effect on their reception to and willingness to use them. Even at individual levels, culture-specific values greatly influence perception of sickness and disease, patient roles, expectations, how much information the patient desires, what treatment modalities are acceptable, gender and family roles, and processes of taking decisions concerning health care [26].

It is important to note that no two patients will interpret what good health care is in exactly the same way. This interpretation will be based on personal backgrounds and experiences which have been found to be influenced to a large extent by factors like age, gender, ethnicity, race, religion, and economic status. These factors influence the perception of the individual who receives a health service or product [30]. Therefore, it is important to note that a culturally sensitive healthcare delivery system limits barriers as regards culture and language thus bringing about desirable health outcomes and positive behavioral adjustments.

Cultural competency is one of the main ingredients in closing existing disparities in access to health care. It is one-way healthcare providers, and their target audiences can always find a common ground as they address health issues. Patients and doctors, population groups, and healthcare organizations can work together to achieve positive health outcomes in such a way that cultural differences become an advantage instead of a weakness. This is possible when the beliefs, practices, and cultural needs of communities are given high priority [31].

Agreement on what terms to use is not universal as words like "cultural responsiveness," "cultural humility," and cultural effectiveness" have been used, each of which has a unique definition. However, a sense of agreement exists based on the fact that each proponent of the above terms has recognized certain aspects of health delivery, especially the patient-provider relationship, as critical part of the concept. What seems to be lacking, however, is the development of a more comprehensive approach to thinking about and implementing cultural competence in health care at multiple levels and from multiple perspectives in order to overcome barriers which exist at organizational and individual levels.

7. Barriers to cultural competence

7.1. Organizational level

Cultural competence of health interventions is largely determined by leadership within organizations as well as discharge of a myriad of functions carried out by individual members of the healthcare team. The degree to which the makeup of major establishments reflect the different groups that make up the target population will influence how culturally adequate the policies, procedures, and decisions made will be. Available evidence suggests that inequalities of representation at strategic, management, and operational levels within the health organization result in poor acceptability and access to health services.

Inadequate minority representation in governance, administrative, and clinical leadership roles causes healthcare systems to be disconnected from the minority communities they serve.

7.2. Case study 1 (a transgression of the principle)

Mr. Audu Bako had just discovered he was HIV positive. It came to him as a shock; despite the fact that he had four wives and several other "mistresses" and never practiced safe sex, he had never thought that this dreaded disease would catch up with him. After all, none of his friends had it. He would never divulge his condition to anyone, not even his wives. If his

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neighbors or coworkers discovered his secret, he would become a laughing stock of the community. He would lose his respect, people would keep their distance from him, even avoid him completely.

He had been referred to an HIV clinic at the big hospital at the center of town. He was not comfortable going there. He would have preferred a place at the outskirts of town or even another town where he was unknown. He cautiously approached the entrance to the clinic which he identified with the large signboard outside it. As he made to enter, he saw his landlord Chief Alfred Nwosu stepping out of the clinic with a polythene bag in his hand, glancing cautiously in either direction as he made to exit the clinic. Audu swiftly changed his direction and hurried away before he was spotted. He walked back to the car park and drove his car away hurriedly. He never came back.

What went wrong? The clinic was located separately from other clinics in the hospital making it easy to identify its clients. In African countries like Nigeria, HIV is still associated with a lot of prejudice against the victim as most people associate it with sexual promiscuity, even blaming patients for their condition. Audu would rather take his chances elsewhere than be seen at the clinic, than to be labeled one of "them."

7.3. Case study 2 (a transgression of the principle)

Dr. Sanjay Patel sat down in his consulting room at the large hospital in Calgary, Alberta, where he worked as an Obs/Gyn consultant providing family planning services. His last client for the day was a middle-aged woman of Asian descent. Her file indicated she was 42 years old and that her name was Mrs. Fei hung Zhao. It also indicated a bad obstetric history and the fact that she already had five children. Three minutes into the interaction, it dawned on Dr. Patel that his client's understanding of English was quite poor. Further enquiry revealed that there was no member of staff who could speak any Chinese. He tried to get across to her with some basic words and a lot of sign language. She refused the hormonal contraception (as an injection or IUCD) which was ideal for women of her age but preferred oral pills. He tried his best to instruct her on how to take them and asked her to return in a month with a family member. Fei hung returned 5 months later; she was 3 months pregnant.

What went wrong? The Mandarin community comprises about 3% of the Canadian population. It is a conservative society and as such Fei hung was not comfortable discussing birth control with a man, especially one of a different race. Not one member of the Chinese community worked in the hospital. The language barrier ensured that she did not understand most of Dr. Patel's attempt to educate her and her rejection of hormonal contraception was because she felt it would make her fat. She misunderstood the directions on how to take her pills and when to return. By the time she got pregnant, she was shocked and disappointed; she really felt she had done all the right things.

7.4. Clinical level

When there is a failure to properly appreciate, understand, and even explore cultural differences during the patient-provider interaction, clinical barriers to healthcare delivery arise.

These differences manifest during interactions with different patients and within diverse settings and situations. A reasonable level of flexibility, perception, and judgment is therefore required.

When cultural and linguistic barriers in the clinical encounter negatively affect communication and trust, it leads to patient dissatisfaction, poor adherence (to both medications and health promotion/disease prevention interventions), and poorer health outcomes.

According to Kreuter et al. [4], "Cultural competence" in healthcare delivery demands three basic skills when quality healthcare delivery to varied patient populations is the focus:

- The ability to understand how sociocultural factors affect personal beliefs and behavior.
- An appreciation of how these factors influence decision-making at all levels of the healthcare system.
- Capacity to design, plan, and implement interventions that take these issues into account.

7.5. Case study 3 (an observance of the cultural competence principle)

Dr. Teta Greene stood in front of a gathering of 120 members of the Freetown branch of the Sande society, a fraternity of Liberian women. Her mission in that community was to start a campaign against the dehumanizing practice of female genital mutilation which had caused untold hardship for many years. When it was time for her address them, Dr. Greene introduced herself and two men who had accompanied her. After a brief introduction, both men proceeded to address the women for the next 30 minutes. By the end of the talk, many women were in tears. Dr. Greene asked women who were willing to help stop the practice among their children, families, and community to raise their hands. More than half of the group raised their hands and gave their names as a sign of commitment. How did she get that kind of response?

Dr. Greene knew that genital mutilation is a ritual for admission into the Sande fraternity so the entire audience had experienced it and were suffering from its various complications. The first speaker was an elderly public school headmaster who was well respected in the community and whose mother had been mutilated as a child. The second speaker was a Catholic priest who was well respected in the predominantly Catholic community. Both men spoke about the dangers of the practice and how the same women subjected to it were its strongest promoters. The message was right, the messengers were ideal, and therefore the required change was achieved.

7.6. Case 4 (an observance of the principle)

The acceptance of family planning in Egypt had been very low for centuries, and as a result, contraceptive prevalence rates were poor and maternal mortality high. However, in the late 1930s, the Grand Mufti, considered the highest authority as far as the interpretation of the Quran was concerned, issued a document endorsing contraception. He stated that contraception was in no way against the tenets of Islam. This led to the establishment of family

planning clinics across the country and positive changes in fertility indices [32]. What brought about this change? In many countries, especially in Africa and the Middle East, the most influential voices are those of religious leaders. Where a health service goes against religious beliefs, wide acceptance is almost impossible even when other cultural factors are taken into consideration. Ensuring that the health "product" is supported by religious institutions is fundamentally strategic in these societies.

Based on the illustrations above, it needs to be clearly stated that cultural competence is required at several critical points within the healthcare delivery process. For ease of understanding, these have been divided into three; organizational, structural, and clinical interventions:

Cultural competence at organizational levels: interventions deployed at this point must ensure a reasonable level of diversity in the composition of leadership and personnel of a healthcare organization to ensure that it is representative of its target population.

Cultural competence at structural levels: this requires efforts to ensure that healthcare delivery processes and activities are designed in such a way that they guarantee reasonable levels of access to quality care for all subgroups within the population that system serves [26].

Cultural competence at clinical levels: interventions required here are steps taken to improve the capacity of a healthcare practitioner to recognize, understand, and harness cultural peculiarities of individual patients in the provision of health-related information and care.

8. Conclusion

In conclusion, the face of health care is changing. The concepts of cultural awareness, cultural competence, and cultural sensitivity are gradually becoming standard terminologies in quality healthcare delivery. It has therefore become more imperative that they are understood and practiced.

With constant changes in the composition of global populations, it becomes more likely that disconnections may exist at points where services are rendered, including healthcare services. It also becomes more important that these differences are managed in such a way that the management of each patient is devoid of bias. Regardless of whether the healthcare provider is a nurse, physician, therapist, admissions clerk, or other professional, there are opportunities each and every day to interact with patients and their families and to succeed or fail in the application of the concepts of cultural sensitivity.

There is compelling evidence that proves the connection between patients' satisfaction with their healthcare providers and various healthcare provider behaviors. This implies that ability to deliver quality health care in its true sense will depend more and more on how much the information and skill the health worker has is "colored" by cultural sensitivity.

Finally, there is a growing need for healthcare workers to be aware of the predominant cultural factors that influence how their clients think and behave. These individuals must be

empowered with skills which enable them to attend to the various collections of people they serve. Several interventions have been recommended and include in-house training, case study reviews, live interactions with patients, role-playing, and the use of continuing education healthcare videos. Regular periodic assessments based on established standardized procedures are also important for objective measurements of progress made.

Author details

Chuka C. Agunwa* and Emmanuel I. Obi

*Address all correspondence to: chukaagunwa@gmail.com

Department of Community Medicine, College of Medicine, University of Nigeria, Enugu, Nigeria

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Section 3

Conditions of Global Importance

Chapter 4

Responding to Cholera Outbreaks in Zimbabwe: Building Resilience over Time

Anderson Chimusoro, Stephen Maphosa,
Portia Manangazira, Isaac Phiri, Tonderai Nhende,
Sydney Danda, Ottias Tapfumanei,
Stanley Munyaradzi Midzi and
Juliet Nabyonga-Orem

Additional information is available at the end of the chapter

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Abstract

Cholera is still a major cause of disease epidemics in sub-Saharan Africa (SSA). During the period January 2017–March 2018, 15 countries in the WHO African Region (AFR) reported cholera outbreaks of varying magnitudes. Zimbabwe has experienced cholera outbreaks dating as far back as 1971 with an unprecedented outbreak occurring in 2008/2009 when 60 of the 62 districts in the country were affected. The outbreak was declared over in May 2009 and by then, 98,592 cases and 4288 deaths had been reported. In Zimbabwe, outbreaks have occurred against a backdrop of a struggling economy and a weak health system. The role of a resilient health system in emergencies response is accentuated premised on experiences from the Ebola outbreak that largely affected three countries in West Africa. Amidst economic and persistent system wide challenges faced by Zimbabwe, preparedness and response capacity has been built over the years. This is evidenced by the rapid response and containment of the recent cholera outbreak. Skilled and equipped rapid response teams, strengthened surveillance and maintaining high alert, effective multisectoral collaboration and high level political engagement are among the critical elements that have built resilience.

Keywords: cholera, outbreaks, emergency, response, resilience

1. Introduction

Disease outbreaks are a common occurrence and often result in untoward suffering and loss of life. Delayed response has led to loss of life, economic losses and disruption of health

systems which are already weak especially in low income countries. Researchers estimated the real total economic loss attributable to cholera in the WHO African Region (WHO AFR) as US$38,958,750 assuming a minimum regional life expectancy of 40 years; US$53,240,859 assuming a regional average life expectancy of 53 years; and US$64,208,880 assuming a maximum regional life expectancy of 73 years using 2015 figures [1]. Further, the three Ebola virus disease (EVD) hard hit countries in West Africa lost an estimated $2.8 billion in gross domestic product (GDP) [2]. Drawing from the experience of the three EVD affected countries in West Africa, the social and economic impact would have been less profound if health systems were strong to respond to the outbreak. The health system capacity in Guinea, Liberia and Sierra Leone was suboptimal [3]. Essential health systems functions were not in place negatively impacting timely response to the outbreak. Scholars accentuate the role of resilient health systems to guard against loss of life, and collapse of basic health care services in the face of a crisis [4].

1.1. History of cholera and risk factors

Cholera, an enteric infection caused by the bacterium *Vibrio cholerae,* causes diarrhea that can lead to severe dehydration and death in people of all ages. Cholera is transmitted through ingestion of food or water contaminated with the bacterium *Vibrio cholerae* and can lead to explosive, widespread epidemics. Humans carry and spread the disease globally. If untreated, the case fatality rate can be as high as 50% while up to 80% of all infections will have only mild or no symptoms at all [5]. Cholera is traced as far back as the nineteenth century when it spread across the world from its original reservoir in the Ganges delta in India. Since then, six subsequent pandemics have been reported across all continents which have killed millions of people. The current pandemic is the seventh which arrived in Africa in 1971. Estimates show that each year, 1.3–4.0 million cholera cases, and 21,000–143,000 deaths occur worldwide due to cholera [6].

During the period January 2017 to March 2018, 15 countries in the WHO African Region (AFR) reported cholera outbreaks of varying magnitudes [7]-as shown in **Table 1**. Risk factors for cholera include poor sanitation and hygiene, inadequate access to safe water [8], reduced or nonexistent stomach acid, cohabitation in the same household with someone who has the disease, type of blood group, consumption of contaminated food and raw or undercooked shellfish [9]. Having an unprotected water source close to the residence, drinking poorly treated water and eating away from home [10] have also been cited as risk factors. Other studies highlight bathing in the river, long distance to water source, and eating dried fish as risk factors [11]. Furthermore, scholars draw our attention to a possible correlation between socio-economic and demographic indices as factors that might serve as national risk predictors with the assertion that, infant mortality and the human development index may denote a risk of sustained transmission of cholera [12]. On the contrary however, other researchers found no association between the risk of cholera and socio-economic factors although they highlight the association between occurrence of severe dehydration in cholera patients and the household size [13]. Peri-urban slums and camps for internally displaced persons or

Country	Date of notification to WHO	Date of latest report	Cases	Deaths	CFR
Angola	15 Dec 2017	25 Mar 2018	861	15	1.7%
Angola	15 Dec 2016	22 Oct 2017	375	21	5.6%
Burundi	20 Aug 2017	31 Dec 2017	171	0	0%
Chad	19 Aug 2017	10 Dec 2017	1250	81	6.5%
DRC	1 Jan 2018	4 Mar 2018	6080	140	2.3%
DRC	1 Jan 2017	4 Mar 2018	60,492	1288	2.1%
Kenya	1 Jan 2018	16 Mar 2018	1910	41	2.1%
Kenya	6 Mar 2017	31 Dec 2017	4079	76	1.9%
Malawi	28 Nov 2017	28 Mar 2018	844	26	3.1%
Mozambique	12 Aug 2017	25 Mar 18	2285	5	0.2%
Mozambique	16 Feb 2017	13 Mar 2017	1400	3	0.2%
Namibia	31 Jan 2018	2 Mar 2018	1	1	0.0%
Nigeria	7 Jun 2017	3 Mar 2018	5058	126	2.4%
South Africa	26 Feb 2018	10 Mar 2018	1	0	0
South Sudan	25 Aug 2016	7 Feb 2018	20,438	436	2.1%
Tanzania	20 Aug 2015 (Cases from 1 Jan 2018)	25 Mar 2018	1445	27	1.9%
Tanzania	20 Aug 2015 (Cases from 1 Jan 2017)	31 Dec 2017	4627	95	2%
Uganda	28 Sep 2017	30 Jan 2018	250	4	1.6%
Uganda	15 Feb 2018	25 Mar 2018	1901	39	2.1%
Zambia	4 Oct 2017	25 Mar 2018	5190	103	2.0%
Zimbabwe	22 Jan 2018	24 Mar 2018	111	4	3.6%
Total			118,769	2531	2.1%

Source: WHO/AFRO Weekly bulletins on outbreaks and emergencies, January 2017–March 2018.

Table 1. Countries in the WHO AFR that have reported cholera outbreaks: January 2017–March 2018.

refugees are typically at risk due to challenges of accessing adequate safe water and good sanitation facilities [12].

In this chapter, we focus on cholera which is still a major cause of disease epidemics in sub-Saharan Africa (SSA). We review the trend of cholera in Zimbabwe and how the country has built resilience overtime. Our findings provide lessons to other countries who are seeking to put in place measures to control cholera and other diseases outbreaks.

2. Methods

2.1. Defining resilience

Health systems must have the capacity to effectively respond to crises and maintain core functions before, during and after crises. Resilience refers to patterns of positive adaptation in the context of significant risk or adversity [14]. A range of definitions for resilience have been proposed including a stable trajectory of healthy functioning after a highly adverse event; a conscious effort to move forward in an insightful and integrated positive manner as a result of lessons learned from an adverse experience; the capacity of a dynamic system to adapt successfully to disturbances that threaten the viability, function, and development of that system; and a process to harness resources in order to sustain well-being [15]. Resilient health systems are defined as health systems that are aware of inherent strengths and weaknesses; diverse with the capacity to respond to a broad range of challenges; self-regulating with the ability to isolate health threats while continuing to deliver core health services; integrated, and bringing in diverse actors from health and non-health actors as well as local and international players in a smart dependence; and adaptive with the ability to transform in ways that improve function in adverse situations [4]. In all these definitions resilient is understood in terms of a continuum of positive response in the face of adverse events.

2.2. Approach to the review

Four of the authors were involved in the response efforts and their insights are provided here along with the review of important literature on the outbreak. The literature yielded information on the nature and trend of cholera response activities between 2008 and to date, and provided insights into changes in the health system over the same period that may have had an effect on the response to epidemics. The review took place between February and May 2018.

3. History of cholera in Zimbabwe

The first recorded cholera case in Zimbabwe was in Mashonaland East Province (Mudzi district) in 1972. In the same year another outbreak was reported in Mashonaland Central (Mt Darwin district) [16]. Thereafter outbreaks occurred every 10 years until 1992. More frequent outbreaks occurred in the late 1990s, with the largest being recorded in 1999 when 4081 cases were reported in low lying border areas covering six provinces. Since the year 2000, cholera outbreaks were reported on an annual basis, with unprecedented outbreaks occurring in 2008/2009, when 60 of the 62 districts in the country were affected, and by the time the outbreak was declared over in May 2009, 98,592 cases and 4288 deaths had been reported [17]. The 2008/2009 cholera outbreak tested the strength of the Zimbabwe emergency preparedness and response at a time when the country was ill prepared for emergencies. Smaller outbreaks occurred in 2010 and 2011 each covering four districts and recording 1022 and 1140 cases respectively but these were controlled in reasonable time given the built response capacity from the 2008/2009 outbreak. After 2011, the country continued reporting cholera outbreaks

Year	Cases	Deaths	Number of districts affected
2008/2009	98,592	4288	60
2010	1022	22	4
2011	1140	45	4
2012	22	1	1
2013	2	0	1
2014	0	0	No
2015	42	0	6
2016	4	1	2
2017	6	3	3
2018	111	4	2

[1]Source: National Health information and surveillance, Ministry of Health and Child Care, Zimbabwe.

Table 2. Cholera cases and deaths in Zimbabwe between 2008 and March 2018[1].

on an annual basis to date with varying magnitudes. Remarkably, from 2012, all the outbreaks have been controlled at source without further spread to other districts. Chiredzi and Chipinge districts remained as hot spots with cases coming from these two districts for most years. **Table 2** shows cholera cases and deaths in Zimbabwe from 2008 to March 2018.

Since 2008, most of the cholera outbreaks in Zimbabwe were in urban settlements where the main drivers of cholera included the overloaded and dilapidated water and sanitation infrastructure which has been deteriorating over the years, inadequate water, contaminated water sources and poor water storage [18, 19]. In addition, cultural practices such as unsafe handling of corpses during burials add to the list of risk factors. In most of the reported outbreaks a great number of cases had been associated with deaths and reported to have attended a funeral [17].

4. Response to cholera outbreaks overtime

4.1. The period from 2008 to 2009

4.1.1. The health system

Zimbabwe's health system is built under the principle of primary health care, with a district health system anchored on a district hospital and a network of rural health centers (RHC) or clinics providing first line health services. The district health system is supported by provincial hospitals at tertiary level and central hospitals at national level stationed in the two major cities of the country.

The first line health facilities are serviced by nurses, for curative services and environmental health technicians (EHT) to support public health preventive services in the community. In addition to nurses, for curative services, the district level has doctors, laboratory scientists and

other clinical and public health experts. The ideal for the country is two to three nurses and one EHT for every RHC. The district hospital is ideally supposed to be supported by 50–100 nurses, and three to eight doctors depending on the size. From independence, the supply of health workers improved up to about year 2000, when almost all the district hospitals had at least one doctor. Nurses' coverage at RHC level had been improving up to a time when every RHC had at least one nurse.

The health system, during the period 2008–2009, was far from being resilient and being able to absorb shocks whilst maintaining normal functionality. By the time the 2008/2009 cholera outbreak struck, the health system was at its weakest. It was characterized by a critical shortage of skilled as well as motivated health workers; critical shortages of essential medicines and supplies and medical technologies; dilapidated health infrastructure; unreliable health information systems and weak surveillance systems; poor service delivery and poor health stewardship under inexperienced health leadership [20]. In one study on community mortality from Cholera in Zimbabwe, the poor access to health services and limited availability of oral rehydration salts were some of the causes for high community mortality [20].

The health system was dysfunctional as far as promoting provision of core health services because of the nationwide economic decline and staff attrition. For instance, most health workers including nurses, doctors, EHTs and laboratory scientist left for greener pastures either within or outside the country leaving RHCs without nurses and many district hospitals without doctors [21]. This left the health system poorly serviced by human resources [22]. According to the World Health Organization (WHO), the ratio of health workers per 1000 population was 0.162 in 2004 dropping to 0.05 in 2007 for physicians and that for nurses and midwives dropping from 1.491 in 1995 to 1.215 in 2009 [23]. With the country's economy at its worst, affected by hyperinflation, financing for health was at its lowest during this period. Total health expenditure was 8.9% of GDP, with out of pocket expenditure constituting 50.4% of health expenditure [24]. Total health expenditure per capita was estimated at $16.21 in 2008 [25]. As such, surge capacity was nonexistent. With the lack of confidence in the health system a good proportion of the population was seeking for health care elsewhere which meant that some threats would not be detected by the health system late. Such a system could not adapt, transform and improve performance in the face of an outbreak.

An up-to-date map of human, physical, and information assets that highlight areas of strength and vulnerability was not in place. Real time strategic health information and epidemiological surveillance systems as well as the use of indicator and event based surveillance systems were not in place. Some information was however available on the vulnerabilities of the population to different threats although not well disseminated to impel action. The functionality of the health information network was at its lowest, human resources were poorly motivated and not available at work to record surveillance data, analyze it and use the information for decision making. The surveillance system which was then largely paper based and not real time was severely affected by the transport and communication systems which were also at a low level.

Resilient systems have the ability to harness human, financial and logistical resources from health and non-health fields, coordinate actors and manage partnerships. The strength of the country was the availability of inbuilt structures for coordination including the Civil

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Protection Committee at all levels of the system, chaired by the local government ministry. Although this committee remained functional, due to the poor economic performance all actors' roles in responding to the outbreak were constrained. Although international players were eager and willing to provide support, the country did not declare the cholera outbreak as an emergency in sufficient time to allow inflow of such support. This is evidenced by the fact that although the first official report of the outbreak was on 22 August 2008, unofficial reports had been circulating in the media much earlier. Since the first official report of the outbreak became public, the Government was silent on the issue until December 2008, when the Minister of Health and Child Welfare eventually declared the cholera outbreak a state of emergency. After this declaration of a state of emergency, donors responded immediately and provided financial support through UN agencies and NGOs to fight the cholera outbreak.

4.1.2. Status on IHR and IDSR

The International Health Regulations (2005), or IHR (2005), represents a binding international legal instrument involving 196 countries across the globe, including all the WHO Member States. The purpose and scope of the IHR (2005) is "to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade." The IHR (2005), to which Zimbabwe is a signatory, has shaped the country's preparedness [26], prevention and response efforts to public health risks, but only after the 2008/2009 cholera outbreak.

The IHR (2005) sets guidelines for core capacities which must be implemented in order to prevent or respond to disease outbreaks and other public health events of international concern. This includes strengthening of core capacities at ports of entry to prevent exit or entry of infectious hazards. Alongside this is enabling legislation, establishment and strengthening IHR national focal points for the coordination of stakeholders and reporting of diseases of public health importance to WHO.

The 2008/2009 cholera outbreak occurred outside the period of implementation of IHR (2005) for the country which was to start in 2011 with discussions and base-lining of country capacities for implementation of IHR (2005). State parties, in line with IHR (2005), are required to strengthen capacities in preparedness and response efforts. This requires countries to have multi-hazards national public health emergency preparedness and response plans which have to be periodically tested, including identification of hot spots and developing mechanisms for resource pooling and deployment during times of emergencies. This kind of plan did not exist before the 2008/2009 cholera outbreak.

Integrated Disease Surveillance and Response (IDSR) was adopted as a tool for detection and response to epidemics by the WHO Regional Committee for Africa in 1998. In Zimbabwe, training modules were developed between 2001 and 2007, national adaptation carried out, training of trainers and training of health workers conducted. Although the training of trainers covered the whole country, cascade training of health workers was at a slower pace because of the limited financial resources. This capacity in IDSR was later to be negatively affected by the health worker attrition. With the coming of IHR (2005) AFR member states agreed that the implementation of IHR (2005) in Africa was going to be through IDSR.

4.1.3. Magnitude of the 2008/2009 outbreak and response efforts

This outbreak, described as the worst the country has ever experienced, resulted in 98,592 cases and 4288 deaths with all provinces, and 60 of the 63 districts in the country affected. The outbreak toll could have been reduced were it not for the lack of resilience in the health system and the adverse macroeconomic and political climate.

The 2008/2009 cholera outbreak came amid repeated calls by all sectors that Harare City Council urgently resolves the dilapidated water and sanitation infrastructure. The outbreak came at a time when the country was experiencing its worst economic downturn when most health institutions were closed down due to unavailability of health workers. Health service delivery was left to non-governmental organizations (NGO). The outbreak response was marred by sluggish response due to several reasons among which were weak health systems and leadership.

Apart from the human resources, the resources required to implement a rapid response where not available at the initial stages of the outbreak because of economic challenges. The harsh economic climate characterized by hyperinflation meant that the common people did not have sufficient funds to get them to the health facility as well as procure the sugar and salt for preparing the oral rehydration solution [20].

4.2. The period: 2010–to date

4.2.1. Building resilience

The situation gradually improved with the various interventions by the government and donor community realizing that there would be no good implementation of donor supported programs without public sector human resources for health. This led to various schemes to support retention of key health personnel at implementation levels including the creation of human resource retention schemes as part of the Global Fund and the Health Development Fund (then the Health Transition Fund). These schemes improved the availability of medicines and supplies for health including human resources which improved the country's responsiveness to emergencies.

With the support of partners, health commodities called the primary care packages were deployed to the health facilities at a regular basis using an approach called the Zimbabwe Informed Push System (ZIP). This improved the availability of medicines and as soon as the situation stabilized, the National Pharmaceutical Company (Natpharm) was capacitated to resume its role as the national supplier of pharmaceuticals and the distribution of medicines reverted back to the pull system. The pull system is whereby the distribution of medicines by Natpharm is on a quarterly basis in response to orders placed by health facilities. The implementation of the pull system followed an intermediary assisted pull system where the district pharmacists made quarterly visits to health facilities and assisted them in placing orders to Natpharm based on the stock levels.

The health information and surveillance system also improved quite significantly with the introduction of the District Health Information Software (DHIS) version 1.4, and then latter version 2.1. For reporting of outbreaks and other public health events under the rapid disease

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notification system (RDNS), the Front line SMS® was adopted for reporting from initial 1200 cell phones procured under the Global Fund using the DHIS 2.1. This system started in 2012 and improved reporting of the weekly disease surveillance system (WDSS) from about 40% to above 90% by 2015, and has maintained timeliness and completeness of the weekly reporting at above 95% from 2015 to 2018 (MOHCC WDSS Reports, 2015–2018).

The initiative to strengthen Rapid Response Teams (RRTs) started during the cholera outbreak of 2008/2009. Tools for guiding RRTs were developed which included the Guidelines for Rapid Response Teams and training of RRTs at all levels. In 2011 a Compendium for Rapid Response Teams was developed to guide the work of these teams. Cascade training of RRTs was carried out since then and in 2016, following the Harare typhoid outbreak, another training of RRTs from 20 priority districts was carried out, mainly focusing on case management and surveillance. The IDSR technical guidelines and training manuals were revised in 2011 and used for training of health workers at all identified outbreak response levels. However because of inadequate funding not all identified health workers were trained.

A number of disease specific guidelines were developed in 2009 and these include guidelines for cholera, typhoid, anthrax and rabies. These were distributed to all health facilities as resource materials for reference and guidance should they meet any of the conditions in their areas of work.

The UN established the Office of the Coordination of Humanitarian Affairs (OCHA), in 2008 and the cluster system was formed. The main clusters that were formed were the Health Cluster, with WHO as cluster lead, the WASH Cluster, under UNICEF, the Food Cluster (FAO), Education (UNICEF) and Protection (UNHCR and IOM). As Ministry of Health structures were not functional at the time, the Health Cluster established the Cholera Command and Control Centre (C4), which became the response organ and nerve center for the cholera response at the WHO offices located at Parirenyatwa Hospital grounds. Technical experts including clinicians, epidemiologists, water and sanitation specialists, health promotion officers, data managers and administration staff were engaged to work in the C4. A Health Cluster Coordinator post was established and filled. The WHO mobilized experts through global outbreak alert and response network (GOARN), and these experts were from United States, Centers for Disease Control (CDC), International Centre for Diarrheal Disease Research, Bangladesh (ICDDRB), Burnet Institute Australia and SMI Sweden among others. Surveillance centers were strategically established throughout the country, and toll free lines were set up for surveillance and real time data transmission to C4.

Cluster Coordination System was established and continued until 2012. The Health Cluster was abolished in 2012, and the Interagency Coordination Committee on Health (IACCH) was re-established, and this coordination system is chaired by the Ministry of Health and Child Care (MOHCC). The C4 brought in the concept of the Public Health Emergency Operations Center (PHEOC) and a room within the MOHCC headquarters was set aside for the purpose.

Community health workers who had almost disappeared in the system were resuscitated following strong recommendations from the C4 and the finding that a significant proportion of the 2008/2009 cholera cases and deaths had been in the community. The Village Health Worker (VHW) training curriculum was reviewed, and the training resuscitated. Through

the support of stakeholders, and using the updated IDSR technical guidelines of 2008, the training has been ongoing since then and the numbers have been increasing steadily, and this greatly improving community health surveillance, awareness and reporting of public health events. Village Health Workers were found very useful in the recent Chegutu cholera outbreak of 2018, supporting in health promotion and surveillance.

The 2008/2009 cholera outbreak in the country drew a lot of interest from the local and international scenes including journalists, scientists and human rights activists [17–22]. From the documentation on the various themes pertaining to this outbreak the country remains with a wealth of information to learn from and avoid similar situations from happening in the future.

4.3. Reaping the results of building resilience: Response to cholera in the aftermath

It should be noted that during and following the 2008/2009 outbreak many positive steps were taken, including:

- Mobilizing resources for supporting and retaining core health workers through the Global Fund, Health Transition fund and other donors.
- Pooling resources for maintaining core health at the primary level through the supply of primary care packages by a mechanism called Zimbabwe Informed Push System.
- Development of key guidelines and training materials for RRTs, IDSR and cholera, typhoid, anthrax and rabies guidelines which are in use to date.
- Training of core health staff in updated IDSR and rapid response.
- Establishment of the cluster coordination systems and the C4 as a precursor to PHEOC.
- Revitalization of the Village Health Worker program.

As a result of the devastation left by the 2008/2009 outbreak, the affected communities still remember the impact this deadly disease can inflict on them. As a result of this the cooperation of the community in the cholera outbreaks following the 2008/2009 outbreak has been exemplary. We describe some important outbreaks to show how the detection and response has been improved.

4.3.1. Chiredzi cholera outbreak: May 2012

Chiredzi was the only district which had an outbreak in 2012. This outbreak which, was controlled within one month, remained localized in Chiredzi and resulted in 22 cases and 1 community death. Although the control took longer than the country's target of control within two weeks, the country's efforts to control this outbreak were commendable and the time taken to control the outbreak was much shorter that the 2008/2009 outbreak which took more than six months.

On the 3rd of May 2012 a case of cholera was reported to a RHC in Chiredzi district in a 30 year old man from a village in the communal areas. Thereafter a number of cases were seen mostly from three neighboring villages. The local response was swift in detection, reporting and

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responding to the initial cases. The Secretary for Health and Child Welfare sent the Director Epidemiology and Disease Control and Provincial Medical Director (PMD) Masvingo on an urgent directive to plan swift action and ensure adequate control of the Chiredzi cholera outbreak. Following communications with the PMD, the National RRT comprising the Director Epidemiology and Disease Control, Deputy Director Environmental Health, Health Promotion and Laboratory Services, WHO, the Environmental Health Alliance (German Agro Action-GAA and Save the Children-SC), European Civil Protection and Humanitarian Aid Operations (ECHO) and the Masvingo Provincial Health Executive teamed up on a support visit to Chiredzi. The National RRT was joined by the PMD, Provincial Environmental Health Officer, Chiredzi District Health Executive (DHE), Save the Children and Action Against Hunger (ACF). Investigations conducted pointed to an adult female who fell ill on 27th April 2012 with diarrhea and vomiting, and subsequently died at home on the 28th of April, as the index case. This cholera suspect had sought treatment from a traditional healer. She was buried on the 1st of May in her village. The burial was not supervised because cholera had not been suspected. Thereafter cases started presenting at a local health facility, three of them with a history of having attended this unsupervised burial.

4.3.1.1. Response measures

The PMD dispatched the provincial RRT to support Chiredzi on 7 May. They investigated, provided supplies and supported the district RRT and the partners on the ground, who had already set up a cholera treatment center (CTC) at the health facility on May 5th. Thereafter there was regular communication between the local, district and provincial teams, and updates to the Provincial Administrator's office. The Chiredzi DHE mobilized one nurse from a mission hospital and three EHTs, one from each of surrounding health institutions, all motorized to boost the staff at health facility receiving cholera patients. The team received support from local partners which included ACF, Save the Children and Plan International. Together they conducted active surveillance, contact tracing, decontamination of infected patients' homes and conducted participatory health and hygiene trainings for the affected villages.

Supplies were said to be adequate; diarrhea kits and laboratory consumables were received from the C4 through Save the Children. Some of the supplies were received from ACF and Plan international. The district also had left over supplies from the past outbreaks. A CTC and two Cholera Treatment Units (CTUs) were set up in health facilities in the catchment area. Case management protocols were delivered to the CTC and were used to guide patient management and staff managing patients had received training in cholera, typhoid and dysentery case management. On discharge the patients received health education; IEC materials, aqua tablets, and soap. The staff seconded were initially doubling up the clinic duties and those at the CTC until they were provided relief. ORT was made available at community level through EHTs and VHWs.

The district laboratory was supported with consumables to conduct rapid diagnostic tests (RDT), culture and sensitivity tests. Laboratory support for this outbreak was very commendable with results of rapid test conducted as well as culture and sensitivity, and with good correlation between the RDT and culture results. *Vibrio cholerae,* serogroup O1, biotype El Tor, Inaba serotype, was isolated. This was the first time in many years that Inaba has been isolated in Chiredzi, Ogawa having dominated in the previous outbreaks.

The district had an average of two nurses manning each RHC. At any one time therefore one was likely to find just one trained nurse as a result of capacity building sessions and workshops being conducted from time to time on the various ministry programs, and at times the nurse aides were left on their own attending to patients. This was the case when the first cholera case presented to the health facility on the 3rd of May. Fortunately the nurse aide had attended to cholera patients during the 2008/2009 outbreak and quickly raised the alarm with the district, resulting in the swift outbreak response that ensued.

4.3.2. Chegutu cholera outbreak 2018

Chegutu cholera outbreak is one of the most recent cholera outbreaks the country faced. This outbreak had the potential to escalate into a massive outbreak because of the prevailing water and sanitation situation in the town, the easy link between the town and the capital, Harare City, which also had worse water and sanitation situation and being a link between the two major cities of the country, Harare and Bulawayo. However because of the built in resilience anchoring on health worker capacity, availability of extension workers, swiftness of response by RRTs and coordination of response through the Civil Protection Committee at district level and IACCH at national level, the outbreak was controlled in 20 days with 106 cases and 4 deaths reported. It should be noted that the four deaths were the alert which occurred before the outbreak was detected.

On the 16th of January 2018, a report was made to the Chegutu District Medical Office of an increase in diarrhea cases at Chegutu Hospital in a male ward in which two cases had died. A follow up visit was made to the male ward and revealed that there were three male cases presenting with watery diarrhea and vomiting. Two deaths had occurred and a stool specimen had been collected from one of the deceased patients and sent to hospital laboratory for culture. The result was received on the 19th of January 2018 confirming *Vibrio cholerae*. The national office was immediately notified on the 19th of January 2018 who also notified WHO on the 22nd of January.

Subsequent investigations revealed that all cases and deaths were associated with a funeral which had occurred in Pfupajena Township of Chegutu on the 8th of January 2018. A visit made to the given address revealed that the deceased (index case) had reported for treatment suffering from diarrhea and vomiting at a local private clinic before her death on the same day. The daughter to the index case also reported for treatment at Chegutu hospital on the 9th of January 2018 where she was admitted and discharged on the 11th. A stool specimen was collected and the results were negative.

It was further established that there was a funeral which occurred on the 29th of December 2017 in the same neighborhood which was attended by two relatives from Zambia (Zambia was at the time experiencing a cholera outbreak). Among those who attended the funeral were members of a religious group who later visited the index case. It is highly possible that the source of infection could have been from those who came from Zambia who could have been healthy carriers.

On notification of the national office, the Minister of Health and Child Care immediately visited the area together with members of the National RRT to assess the situation and advise on

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the correct course of action in support of actions that had already started. Isolation of patients requiring hospitalization and appropriate rehydration, infection prevention and control in the hospital, safe and dignified burials, water quality monitoring and health promotion activities were already ongoing.

A follow up visit by the Minister of Health and Child Care was on the 20th of January, teaming up with the local member of parliament and a minister colleague in the president's office, in the company of the WHO Officer In Charge, to provide further support to teams on the ground and assess the evolution of the outbreak. On the 20th of January, the National RRT together with the District RRT worked together with the Civil Protection Committee, chaired by the District Administrator and allocated tasks to teams on the following thematic areas: (i) Coordination, (ii) logistics, (iii) Case management and surveillance, (iv) Health and hygiene promotion (v) Water, Sanitation and hygiene. The teams became immediately operational with coordination meetings taking place twice a day at district level. Community members were trained to participate in contact tracing. A treatment camp was set up to receive patients for diagnosis and treatment. Food premises were inspected and those not meeting minimum health requirements closed. Water quality monitoring was carried out and samples taken for testing.

At National level the IACCH started coordination meetings on a weekly basis with the National RRT having daily coordination meetings. A cholera preparedness and response plan was developed and used to guide the response. Gaps in the response were identified and filled by the donor community, UN, NGOs and the private sector.

5. Discussion

Among the major issues we single out as having been strengthened over the years are the political commitment, multisectoral engagement, capacity to harness resources and coordinate actors, surveillance and RRT and, the health system capacity.

Political commitment is evidenced by the personal involvement of the Minister and other senior MOHCC staff, provincial and district health leadership. The role of political commitment in implementation of health programs is emphasized in literature and indeed effective institutionalization of cholera control measures has been reported in Mexico following the recognition of cholera as a national security problem [27]. The central role of high level political commitment in instituting rapid response measures and mobilization of resources is underscored [27]. Leadership at high level is a necessity for the response if properly managed, but in situations where it is not properly managed [28] it may lead to conflicts among workers in the field thereby delaying the implementation of activities and allowing the prolonged progression of the outbreak. Liberia offers a good example of proper coordination of response with high political leadership during the Ebola outbreak [29]. In the Zimbabwe cholera outbreak of 2008–2009, the failure by the political leadership to accept that a cholera outbreak was brewing led to delays in the response allowing uncontrolled continued infection and the resultant mortality. In years after 2008/2009 outbreak, political leadership has been prominent in all the outbreaks and their control within reasonable time can be explained.

We also note the importance of multisectoral engagement in emergency response and in particular, these reported recent cholera outbreaks. Multisectoral engagement is observed in the name of the cluster system during the cholera outbreak of 2008/2009, the civil protection committees at various levels led by the ministry of local government and the IACCH, all for the purposes of streamlining and coordinating the response. The success of controlling the cholera outbreaks is built upon functional multisectoral engagement. The Global Task Force on Cholera Control's Ending Cholera—A Global roadmap to 2030, recognizes multisectoral engagement as one of the three key axis for cholera control [30]. The key cholera drivers are largely known and most of them are outside the health sector. The tools for prevention and control of cholera outbreaks are also known to work and anchor on improving access to clean water and improving sanitation, improving community awareness and hygiene practices including the hand washing [10–13]. The health sector is mainly responsible for responding to outbreaks in terms of case management and surveillance. The requirement of multisectoral engagement becomes more important realizing the limitations of the health sector in cholera prevention efforts.

Over the years Zimbabwe has witnessed rapid response to, and reducing case fatality rates from, cholera. The investments made over the years to strengthen the health system partly explain this phenomenon given the fact that the cholera case fatality rate reflects the access to basic health care [31]. Availability of HRH, strengthened surveillance and improved availability of basic commodities have been realized over the years. The per capita expenditure on health increased from $9 in 2009 to $24 in 2015. Regarding retention of health workers, average in-post rate stands at 81% [32]. Indeed the Ebola viral diseases outbreak in West Africa brought to the fore the central role of strengthened health systems in responding to diseases outbreaks [3, 4, 33].

The presence of skilled rapid response teams, especially following the scale up of training following the 2008/2009 cholera outbreaks, as well as the recent training sessions in response to the typhoid outbreaks in Harare, has improved the capacity of health workers to manage epidemics. Health worker capacity for rapid detection and swift control of outbreaks is essential in emergency preparedness and response [34]. RRTs which are multidisciplinary teams ensure this takes place and where they are functional this has led to reduced mortality and shortened period for control [35]. The timing of activation of RRTs is also important for good outcome for delayed activation may also lead to increased mortality.

Correct information is necessary for the communities to take appropriate action to prevent infection or to get immediate assistance when they get infected [36, 37]. The sustained information dissemination through the district structures made the people**'s** perception of risk remain high and to quickly adopt responsible behaviors as advised. Majority of the population anywhere in Zimbabwe still remember and reminisce the events of 2008/2009 which left them devastated and hence are very responsive to behavior change communication messages. Lessons from the field show us that when inadequate information is given it may lead to information gaps allowing unorthodox sources to lead with misinformation resulting in panic or inappropriate actions [3]. On the other hand clear information dissemination on a regular basis from trusted sources has led to communities taking part in the response measures leading to rapid containment of epidemics as reported in Uganda during an EVD outbreak the

country faced [3]. Furthermore, surveillance is a key requirement for epidemic detection and control. Zimbabwe has registered improvement in this area and has built capacity for real time reporting. This has enabled fast detection and response to outbreaks. Capacitation of health workers in IDSR has improved their interpretation and use of data at local level.

6. Conclusion

Emergencies and in particular outbreaks of infectious hazards remain a global concern. The IHR (2005) together with other guiding documents on specific themes on emergency preparedness and response remain available to guide countries in building capacities for emergency preparedness and response. The capacity of countries to mount adequate response to control emergencies depend on the resilience of their health systems build upon organizational, community and individual resilience and to a large extent dependent health systems institutional capacities as defined by the WHO health systems building blocks.

Zimbabwe having gone through a period of economic difficulties, faced one of its worst ever cholera outbreaks, which resulted in high rates of infection and deaths. This being said the country managed to use this event as a stepping stone which has resulted in the country building resilience to mount adequate response to outbreaks in the recent years. Understandably, resilience is not an all or none event but a process with levels of attributes, and Zimbabwe continues to work towards achieving all resilience attributes. Other countries can learn from Zimbabwe's experience to build resilience.

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Conflict of interest

None declared.

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Abbreviations

ACF	Action Contra La Fame
AFR	African Region of the World Health Organization
C4	Cholera Command and Control Center
CTC	cholera treatment center
CTU	cholera treatment unit
DHE	District Health Executive
DHIS	District Health Information Software
ECHO	European Civil Protection and Humanitarian Aid Operations
EHT	Environmental Health Technician
EVD	Ebola virus disease
FAO	Food and Agricultural Organization
GAA	German Agro Action
GOARN	global outbreak alert and response network
IACCH	Inter Agency Coordination Committee on Health
IDSR	Integrated Disease Surveillance and Response
IEC	Information Education and Communication
IHR	International Health Regulation
IOM	International Organization for Migration
MOHCC	Ministry of Health and Child Care
NGO	non-governmental organizations
OCHA	UN Office of the Coordination of Humanitarian Affairs
ORT	oral rehydration therapy
PHEOC	Public Health Emergency Operations Center
PMD	Provincial Medical Director
RDNS	rapid disease notification system
RDT	rapid diagnostic tests
RHC	Rural Health Center
RRT	rapid response teams
SC	save the children

SSA	sub-Saharan Africa
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children's Fund
VHWs	village health workers
WASH	water, sanitation and hygiene
WDSS	weekly disease surveillance system
WHO	World Health Organization
ZIP	Zimbabwe Informed Push System

Author details

Anderson Chimusoro[1]*, Stephen Maphosa[1], Portia Manangazira[2], Isaac Phiri[2], Tonderai Nhende[2], Sydney Danda[2], Ottias Tapfumanei[2], Stanley Munyaradzi Midzi[1] and Juliet Nabyonga-Orem[3]

*Address all correspondence to: achimusoro@gmail.com

1 World Health Organization, Country Office for Zimbabwe, Harare, Zimbabwe

2 Department of Epidemiology and Disease Control, Ministry of Health and Child Care, Head Office, Harare, Zimbabwe

3 World Health Organization, Inter-Country Support Team for Eastern & Southern Africa, Health Systems and Services Cluster, Harare, Zimbabwe

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Chapter 5

Physical Trauma and Its Consequences in Rural and Semi-Urban Regions of Low and Middle Income Countries

Haleluya Imanueli Moshi

Additional information is available at the end of the chapter

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Abstract

Trauma is a common occurrence in the rural and semi-urban regions of the low- and middle-income countries (LMICs) due to existence of risky infrastructure, socioeconomic, and cultural environments. Causes of trauma in these regions range from the commonest road traffic accidents, falls, burns, and assaults to the scarcely reported range of farmyard accidents. A majority of persons who survive trauma in these areas are evacuated from the incident scene and transported to the health facilities by laypersons by using any available vehicles. This state of handling potentially exposes trauma survivors to secondary injuries, worsening the disability and heightening risk to prehospital death. The cost managing persons with trauma is overwhelmingly high for rural areas of LMICs. Most governments of LMICs are not prepared to cater for individual traumatic incidents; so, if a permanent disability is a final outcome, the injured person and the immediate family have to bear the whole rehabilitation cost. In most cases, these rehabilitation costs are either unaffordable or unavailable to the family leading to provision of inappropriate assistive functional and mobility devices. Broader consequences include the inability to engage in income generating activities, while continuously draining the family economy, hence a poverty-disability vicious cycle.

Keywords: trauma, rural and semi-urban regions, low and middle income countries

1. Introduction

Though rarely reported, physical trauma remains one of the major causes of mortality and disability in the rural and semi-urban regions of the low and middle income countries (LIMCs). Unlike in the high income countries, where most occupational injuries happen in

the formal sector and transportation, trauma in LMICs particularly rural regions occurs in informal occupations that are seldom monitored by occupational health laws and regulations. For example, a majority of the working class in the developing rural regions are informally self-employed in agricultural and entrepreneurship activities that are not governed by any occupational health and safety regulations. It can fairly be perceived that there are more factors for physical trauma in LMICs, as compared with developed regions, and so prevention is multifarious.

Causes of physical trauma in the rural and semi-urban regions are as diverse as the diversity in geographical, cultural, and socioeconomic features of these areas. For this reason, even within the same country, strategies to prevent and manage physical trauma ought to consider these variations. Furthermore, rural traumatic causes of physical injuries are significantly different from those dominating big cities even though they may be in the same country. For example, activities that involve climbing trees (from which one may fall) or working in the farmyard, hence a risk of being bitten by venomous insects or animals, are rare in big towns and cities of the high income countries but common in rural LMICs. Furthermore, individuals living in these regions continuously face danger of being attacked by either a domestic or wild animals which may charge and cause injuries. In one study in Ethiopia, both hospitalized and nonhospitalized persons who had suffered a dog bite were enrolled, and it was shown that more than 655 persons had suffered such injuries in a period of 1 year only [1]. Regardless of the population size, it is obvious that this is a high incidence rate and reflects poor legislation governing domestic animal keeping in most LMICs. Legislations for keeping domestic animal which are either ill-stipulated or lightly implemented add a risk of animal-related trauma to individuals living in LMICs. Furthermore, environmental and socioeconomic activities that add to the risk of trauma to the inhabitants of the rural areas are living in unsafe buildings, cooking in open fires, frequent head loading, working with sharp cutting objects, and working up or under trees. Head loading is the act of carrying heavy load on the head as means of transferring objects over a considerable distance. Head loading is a very common act among LMICs rural inhabitants in their crucial attempt to collect water, firewood, cattle feed, and crops to the homes or market place. In one of the centers for rehabilitation for persons who are paralyzed in Bangladesh, it was shown that for 3 years at least 84 persons had suffered cervical spinal cord injury as a result of falling while carrying heavy load on the head [2].

Trauma is costly in terms of evacuation, transportation, and management, and it is even worse when the individual has to remain permanently disabled. In the LMICs, this cost is normally borne by the individual and or immediate family as most countries have weak social support for a disabled person. Bearing in mind that rural and semi-urban regions of LMICs are residences for the poorest, this cost is unbearable in most cases. This unmet cost could explain the reported unavailability and unaffordability of transport services for trauma victims in these regions [3]. Delays and mismanagement of a traumatized person due to lack of appropriate equipment adds to the risk of secondary injury and death. Poorly managed and or rehabilitated victim of any physical trauma is at higher risk of health complications, dependency and in the worst case scenario, death.

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The author of this chapter is a senior physiotherapist and assistant lecturer at the Kilimanjaro Christian Medical Centre and University College in the North-East of Tanzania. Being born here, he has witnessed serious traumatic incidents resulting from very diverse risky activities and environment of rural and poverty-stricken regions within and around the Kilimanjaro region. While taking his Masters Studies for 2 years in Cape Town—South Africa, he had a chance to supervise undergraduate students in their clinical placement in Groote Schuur and Tygerberg hospitals in the Western Cape. He noted that in the Western Cape, the leading causes of trauma were far different from those dominating Tanzanian rural and townships. Furthermore, he wrote his Master's thesis (and now PhD) on occurrence and life after spinal cord injury in the rural settings of Tanzania. In both of his endeavors, he further noted that spinal cord injuries in rural settings of the LMICs result from various causes unique to these areas. In this chapter, he takes what he has learnt over the years as a clinician and a researcher and supports this with various studies from other settings with relatively similar characteristics. The literature search to support each subtopic of this chapter was carried out in PubMed, reference lists of various studies, and Google Scholar. Commonly used terms during the search were Trauma, injury, Rural, developing countries, low and middle income countries, and etiology.

2. Causes of trauma in the rural and semi-urban regions of LMICs

2.1. Road traffic accidents

Road traffic accidents are reported to be the leading cause of trauma and death globally due to the resulting fatal injuries, worse in most parts of LMICs. A novel cohort study carried out in sub-Saharan Africa reported that most of serious injuries in rural and semi-urban regions were due to road traffic accidents [4]. In rural areas of Bangladesh, for each 1 million people, 8890 gets injured of whom 60 dies annually due to road traffic accidents alone. It was also found out that of those who sustain RTAs as pedestrians, one-third died [5]. Still, like in many other trauma epidemiologic studies in LMICs, those who died before arriving to the hospital were lost to the count. For this reason, the reported figures do not reflect the true magnitude of the problem.

There are unique environmental, economic, and sociocultural factors that make RTAs prevalent in these regions of the LMICs. First, the number of vehicles does not match the available road space; hence, there is a congestion of pedestrians, cyclists, trees, and two motorcyclists. Most African rural and semi-urban regions have witnessed an influx of three- and two-wheeled motorized vehicles as means of public transport, while the number of roads and structures remains more or less the same. Following the increase of motorized vehicles in limited road space in the LMICs, especially in the rural regions, the incidence of RTAs in the recent years has been escalated. A recent population-based study in one of the Tanzanian rural areas indicated that most road traffic injuries (RTIs) were due to motorcycle accidents, affecting males in their twenties [6]. Furthermore, most roads in LMICs have neither traffic

lights nor warning signs and neither pedestrian walkways nor cyclist pathways. For this reason, motorized and nonmotorized vehicles and pedestrians share the same narrow road adding to the risk of accidents and trauma.

Most public busses in the rural and semi-urban regions are of poor quality due to aging or lack of maintenance service. As such vehicles are normally few when matched with the number of commuters, they are normally overloaded with passengers to alarming levels. It is also the scarcity of appropriate passenger vehicles that leads to the use of trucks and tractors which are not meant for passengers. Accidents involving such trucks and tractors normally causes massive trauma and deaths as the passengers are not secured at all. It is also not uncommon for drivers to be found without a driving license, driving drunk, or over-speeding and other human errors that contributes to risk of accident. Two studies carried out in LMICs reported that driving drunk, not applying protective measures, and over speeding were associated with increasing incidents of RTAs [7, 8]. The combination of human errors, vehicle defect, and risky infrastructure describes the reported high RTA incidents in the LMICs. Up to 74% of fatal RTAs in LMICs involve pedestrians [9]. Police road traffic accident data in Ghana showed that more than 40% of fatal RTA involved pedestrians, the majority being women [10]. Women being more affected as pedestrians in the LMICs can be explained by the fact that they are common venders and hawkers of food and items such as used clothes in rural and semi-urban LMICs. To carry out these activities, they have to walk or station themselves on the roadside to attract customers. On daily basis, many women share the insufficient road space with the four-, three-, and two-wheeled motorized and nonmotorized vehicles on their way to or from market, farm, or other places where they earn their living. In these situations, accommodate the current traffic, enforcement of the present laws, risk awareness, and behavior change campaigns by road users (particularly drivers of the motorized vehicles) may significantly reduce these such women are continuously exposed to risk of RTAs and trauma as pedestrians, while male subjects may be involved in RTAs as passengers or drivers. While it is costly and may take long to correct the infrastructure (increasing road space), immediate programs such as mass campaigns to promote safe use of roads by drivers and pedestrians could reduce RTAs.

There are other factors to road traffic accidents and trauma predominantly in the rural and semi-urban regions. Excessive alcohol consumption increases not only the odds of RTA but also assaults and falls which altogether accounts for incidents of physical trauma [4, 11]. Drunk-driving is one of the known major factors of RTAs, especially among youths in the rural and semi-urban regions of LMICs [12–14]. In one of the studies carried out in Tanzania, in which all injured drivers were tested for alcohol use it was found that up to 30% had exceeded the allowed levels [11]. This situation can be explained by the fact that there is quite a few number of road traffic police officers in these regions to monitor drivers behavior including alcohol consumption. On top of that, alcohol is easily accessible in these regions due to presence of alcohol outlets (bars) in almost every corner and people can drink at any time they wish. Some countries such as Tanzania have passed a law that restricts alcohol business during working hours with the aim of increasing productivity and crime reduction. This restriction can also reduce incidents of drunk-driving and minimize alcohol-related RTAs. Still, reducing the number of alcohol outlets and its frequent use in the rural and semi-urban LMICs is complex as it has to do with behavioral change and interferes with socioeconomic

and cultural values of the people. For example, local wine is one of the business relied on by families in one of the sub-regions of Tanzania and Angola and also such brews has social and cultural values [15, 16]. This means to reduce alcohol use in such regions requires extra effort in convincing people to change behavior and also encourage them to engage in alternative income generating activities.

There has been emergence of two- and three-wheeled motorized vehicles for public and private transport in many LMICs, particularly in rural and semi-urban regions [9, 17, 18]. These additional motorized vehicles have made the traffic denser and account for increase in the incidence of RTAs and injuries, especially in the lower limbs [10]. In Gambia for example, two-thirds of the RTA involved pedestrian, bicyclist, or motorcyclist [19]. Together with limited road space, there are several other safety issues to be addressed when motorcycles are used as means of public transport. Among such issues are adherence to safe use road by the cyclists. There are many cyclists in these regions who do not wear helmets and many of those who does, have inappropriate ones. For this reason, motorcycle accidents in these areas expose both the driver and passenger to head trauma. Furthermore, significant number of motorcyclists overloads the motorcycle by either carrying more than one passenger or other heavy loads beyond its ability [7, 17, 18]. It is therefore difficult for the driver to control the motorcycle especially in the case of emergency stop or changing direction, leading to accident and trauma. Most motorcycle drivers are young men in their teens and twenties, who are normally overconfident and feel proud to ride fast to catch up with "the next passenger" as soon as possible. In doing so, they add to the risk of accident and severity of the resulting trauma.

When these factors which precipitate the occurrence of RTAs in rural and semi-urban regions of LMICs are closely observed, it is noticeable that there are many which are modifiable. Some of these trauma precipitating factors can be addressed in the short-term and others in long-term plans. For example, while it may take long time to make better safer roads and a review on current driving regulations (where necessary), short-term efforts could be directed to correcting human errors such as speeding and drunk-driving. In order to reduce human errors that lead to accidents and trauma, the first step would be educating the public on safe road use and guiding them into perceiving of accident and trauma. People are more likely to respond if they perceive that they can sustain accidents and injuries and that this would affect their lives significantly. This is very much possible especially when it is done by engaging schools, spiritual institutions, and potential people who are trusted by the people such as political and faith leaders. In this way, road users (drivers, passengers, and pedestrians) will know their responsibilities and perceive the risk of trauma, injuries, and death linked to violation of road regulations. Hughes and colleagues presents a summary of models that have been used to reduce RTAs which can (selectively) be applicable in rural and semi-urban regions of LMICs as well [20]. Although rural and semi-urban regions of LMICs are understaffed with traffic police, civilians could be empowered to report on violated road regulations such as speeding, suspected drunk-driving, and overloading by calling or sending text messages to the nearby police station. In one study in Uganda, it was reported that almost a half of RTAs were precipitated by reckless driving [21]. This is possible because significant number of people in these regions have access to a cellular phone.

2.2. Falls

Although road traffic accidents and falls are known as the leading cause for trauma in many parts of the world, there is still no single cause that dominates every region. Generally, falls are the second leading cause of trauma globally, but in some regions fall incidents surpass RTAs due to the predominating socioeconomic and cultural activities. For example, in a countrywide population-based study in Nepal, it was shown that falls were the leading cause of trauma followed by RTAs [22]. In most cases, falls from height in the rural and semi-urban regions of LMICs are a result of socioeconomic and cultural activities that involve climbing trees. Socioeconomically there are several reasons why people in the rural and semi-urban regions of LMICs climb trees. First, climbing trees is necessary when one want to obtain fruits, which are either consumed by the family or sold to generate income. For example, falls from coconut trees and other types of fruit bearing trees have been reported in various rural regions of the LMICs [23, 24]. Falling from palm trees is a common occurrence in the West African countries as they harvest palm heads and fruits for wine making [25]. In other incidents, people climb on prune trees to obtain dry branches or green leaves for firewood and animal feed, respectively [24]. Unlike the adults, children may climb trees in search of edible seeds and fruits or just for fun (e.g., pursuing small animals such as squirrels and demonstrating "climbing skills"). While up in the trees, one might lose a grip, an old branch may be broken, or attack by stinging insects or a snake may occur causing one to fall down.

Trees are not the only height from which trauma occurs in rural and semi-urban regions of LMICs. Other common heights from which people commonly fall are roof tops during construction or balconies, which are unsafe [26, 27]. These incidents are as a result of violation of occupational and residential safety guidelines either by ignorance or inability to afford safe construction materials. Depending on the height, injuries and fatalities are a common outcome of such fall incidents.

In these regions, there are significant number of events whereby falls happens as a result of slipping due to uneven road surface and wet or graveled rough road or pathways. These risky road surfaces coupled with absence of road lights and hardly any warning signs add to the risk of falls particularly during the night. For these reasons, falling while walking is a common occurrence especially among the elderly whose sight and protective balance are daunted. Although falls among elderly is globally common, those who live in the rural and semi-urban areas of LMICs have added risk of unfriendly road and pathways. The World Health Organization study on global aging and adult health involving LMICs reported more incidents of falls among elderly women than men and that rural dwellers had higher odds of fall as compared to those in townships and cities [28].

The worst case scenario is when individual falls with a heavy load on either the head or back. This may cause head, spine, and/or spinal cord injury especially on the cervical or lumbar region [24]. Various other consequences related to head loading including musculoskeletal pain disorders and minor injuries occurring in the spinal column, which may cause pain in the long run [29, 30]. In these regions, head loading normally happens in the market places by persons

who routinely carry heavy loads from the car to the market and vice versa. Also, common are women and children getting farm produce to the house or market, carrying water using containers of different shapes and sizes as well as getting animal feed or firewood to the home among other necessities [29, 31]. The load carried on the head could be firewood for cooking, grasses, and leaves for animal feed or farm produce (cereals, banana, bags of fruit and vegetables) from farm to home or to the market [29, 30]. Of recently, head loading has been referred to as a significant cause of disability in LMICs [30].

2.3. Armed conflicts and wars

Violence of any scale in which force and weapons are involved leads to enormous physical injuries and death. LMICs are disproportionally affected by armed conflicts due to rivalry between particular ethnic groups within or between countries. Although armed conflicts and wars are global, such incidents are predominantly more pronounced in the LMICs. Of recent years, armed conflicts are reported in various LMICs such as; Ethiopia, Libya, Nigeria, the Central African Republic, the Democratic Republic of Congo, Nigeria, Sudan, and South Sudan just to mention some. It is estimated that of all traumatic incidents resulting from armed conflicts, more than 50% are in Africa involving both the armed forces and civilians [32]. Following the Libya unrest of 2011 only, 1761 gunshot injuries were treated in one of the hospitals of whom more than 72% were directly associated with war and more than 27% involving stray bullets and civilian fighting [33]. In one of the military hospitals in Pakistan, 170 combats were identified in the period of 2 years in whom injury to blood vessels due to gunshot were reported. These combats required emergence repair of the injured blood vessels to serve their lives [34].

Although the most frequently reported war injuries are in the extremities, other body regions such as the head and spinal cord, thoracic, peritoneum, and pelvis sustain trauma are life threatening [35]. In order to save life and prevent disabilities, war injuries require timely medical and surgical response. However, in LMICs it is fewer victims of armed conflicts who get such a timely medical and surgical management, hence poorer outcome such as limb amputation and high mortality rate which could otherwise be reduced.

Consequences of war-related trauma are very extensive running from affecting the victims physically and mentally to stunting country's economy. In LMICs, trauma is an added burden to the already constrained economy. An injured victim of war who lives within environment of unrest and poverty faces a broader impact. First such person's ability to attain food, shelter, and clothing like everyone else has been shuttered. Second s/he needs medical, rehabilitative, and psychological services which are scarcely attainable. In most circumstances, the country's response to emergency situation is overwhelmed. In this situation, the injured victims may have to seek medical and surgical care from the nearby countries as refugees. In doing so, the consequences of war and unrest are spread to a wider geographical area. For example, between 2005 and 2007 only Iran received 130 injured victims of war from neighboring countries seeking medical and surgical services [36]. This means that the cost of managing war-related injuries in LMICs is incurred by a wider geographical region, draining even the economy of neighboring countries.

Armed conflicts not only cause physical trauma, but also increases mortality rate. For example, while it is estimated that the crude mortality rate globally and in sub-Sahara region are 1.2 and 1.4, respectively, that of DR Congo during the unrest of 2006/2007 was 2.2 deaths in every thousand people. The mortality increase is not only on adult population for there are reports showing indicating an increase in death rate to post-neonatal in war born regions [37]. Furthermore, armed conflicts create poor living conditions and economic insufficiency. Although many people die as a result of direct trauma during the conflicts, many more are likely to die due to the resulting socioeconomic and environmental constraints such as disease outbreaks and hunger. Armed conflicts are so traumatic that they cannot be forgotten easily. For this reason, even those who survive the war, whether injured or not, still suffer depression.

2.4. Other causes of trauma

Other causes of trauma are less common when compared to road traffic accidents and falls but are of a relatively high incidence in the low and middle than in the high income countries. These other causes include; burns, assaults (either by human or animals), being fallen over by heavy load such as injuries due to a collapse of a wall, tree, or landslide. These causes make a big distinct epidemiological difference between LMICs and high income countries. Burns are among the most common cause of severe injuries, mortality, and disability which affects children than adults.

Assault incidents are frequently reported in these regions and in some studies in South Africa, Uganda, and Latin America are rated as the leading cause of trauma ahead of RTA and falls [4, 38, 39]. Assault incidents in these regions are associated with alcohol consumption, interpersonal, and ethnic conflicts [40, 41]. Poverty as a result of high levels of unemployment among youths in these regions is also associated with violent crimes and attempt to earn a living by illegal means which includes forceful robbery. Incidents of alcohol consumption and violent behavior within lower and middle income countries can further be described. First, availability of local brews in so many alcohol outlets (bars) within the communities offers an opportunity people to access it easily. Local brews are cheap and are socially shared so that even those who cannot afford can still get a drink from a friend. Second, there are social events such as weddings, after burial and thanksgiving in the rural and semi-urban communities in which people can get local brews for free during such occasions. All these features increase accessibility to alcohol for the rural and semi-urban regions of LMICs. As a result, incidences of violence and assaults related to alcohol use increases simultaneously with the increase in traumatic incidents.

Venomous snakes, insects, and other animals that can bite and cause serious injuries are also common especially to rural areas of the LMICs. For example, in Bangladesh, rural areas snake bite had incidence of about 624/100,000 person years, the majority of who works in the farms [42]. In one study from India, most deaths from envenomation were due to scorpion stings and affected mostly the children in rural regions [43]. The incidents of snake bites are so common, and the World Health Organization has issued a guideline for management of such injuries [44]. Despite the issuing of the guideline by the WHO, the challenge that remains is making it accessible to the rural dwellers of the LMICs. Even when the guideline is accessed, read, and understood by the people, they may need to be enabled to attain the tools and equipment to respond to such incidents accordingly.

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3. Common causes of trauma to children in the LMICs

Children in rural LMICs incurs trauma frequently from various causes. Although children are also affected by RTAs and falls common causes of trauma in this group for rural and semi-urban regions is burns. Most of the burn injuries to children in these regions happens in the kitchen during cooking but may occur in other activities [45–47]. The use of open fires for cooking in areas is unsafe to children and elderly and ignorance on fire dangers are some of the contributing factors to burn accidents. In Uganda, it was found that burn is the leading cause of injury to children and in one hospital in Iran up to 47% of the burn cases were children less than 16 years of age [48]. Elsewhere in Bangladesh, a population-based study indicated that to every 100,000 children, 528 sustain burn injury of whom two may die while others recover with substantial impairments [45]. However, some studies reported that youth sustain burn injuries even more than children do. For example, in Nepal, it was found that young persons at the age between 24 and 25 had higher incidents of burn injuries than children [46]. A situational analysis of acute burn management in 32 low- and middle income countries indicated that most of the health facilities particularly in the rural and semi-urban regions were not equipped for burn management [49]. This being the case, it is reasonable to expect children who sustain burn injuries in these regions to have higher risk of disability and mortality as compared to those in higher income countries, where healthcare is more prepared for such incidents.

Apart from burn injuries, children in the rural and semi-urban regions of LMICs are faced by risks of other forms of physical trauma just like adults. As most of the rural areas of LMICs are characterized by trees and scarce play grounds, children not only tend to climb trees as part of their plays but also in search of edible seeds and fruits. In Bangladesh and India falling from height is one of the leading causes of trauma to children predominantly males dwelling in the rural and semi-urban regions [50, 51]. There are also accounts of children falling from poorly constructed balconies and windows of which the majority dies and the remaining suffering serious injuries with potential for a long-term disability [27]. In India it was reported that fall from height is the second cause of pediatric head injury next to RTAs [51–53]. Incidents of RTAs involving children and teenagers in LMICs are markedly high as compared to the high income countries [54]. This increased risk of being involved in RTAs can be explained by the fact that a majority of children and teenagers walks to school (pedestrians) or plays near roads where they are exposed to accident and other forms of road-related trauma. Crosswalks are few and where available, they are either not used by children due to ignorance or abused by the drivers or motorized vehicle. This problem could be reduced significantly if community members could volunteer in one accord to guide children in safely using the roads especially when going or coming from school. There is a saying in Kiswaili that "Mtoto wa mwenzio ni mtoto wako" meaning that your fellow's child is yours. If such a saying is used in this setting, it means every person will view the child on the road as his or hers, hence ensuring safety to every child.

It is common in these regions for children to join their parents in different socioeconomic and cultural activities such as feeding cattle and farm works in what can be regarded as "learning by doing." While assisting or performing these tasks by themselves, children frequently sustains physical trauma due to mismatch between the forces demanded by the task against

their physical abilities. Furthermore, children may not perceive risks of falling and getting injured as adults do. These two facts may account for injuries sustained by children when working in the rural and semi-urban regions. A study from one of the rural areas of Nigeria reports that most children with ocular injuries sustained were injured while working in the farms or playing [55]. Furthermore, children are comparatively vulnerable to physical trauma during dangerous incidents that may happen in their residences. These dangerous incidents are such as a fall of a poorly constructed house, throwing of wreckages during strong winds, earthquakes, and heavy rains. Youths and young adults may manage to escape in such disastrous incidents, while a majority of children fail to do so hence sustaining physical trauma.

4. Emergency services following trauma in the rural and semi-urban regions of the LMICs

There is evidence that prehospital mortality can be reduced significantly by good emergency services following trauma which includes first aid and timely and safe transport to health facility [56]. In most LMICs reporting and life supporting systems to sustain the injured person and transportation to health facility are unreliable and indeterminate [3, 57]. It is common for injured person in rural and semi-urban regions of LMICs to be handled haphazardly at the trauma scene and transported by laypersons to the health facility by any means possible. For example, in Zambia, a report showed that the majority of injured persons were transported to the hospital by private cars and it was less than 6% who were transported by ambulance after trauma [3]. In this way, there is a significant delay to get to a health facility and increased risk of secondary trauma and mortality. In most cases, an injured person is given what is regarded as "first aid" by laypersons who happened to be at the incident scene. While such effort to save life is with good intention, this could be of more harm than helpful especially when handling delicate cases such as severe visceral, chest, head, and spinal cord injuries. Noting this danger, some programs to train laypersons on assisting and transporting a trauma victim have yielded convincing results [3, 58].

While training civilians to help trauma victims seems to be the best option for countries where emergency services are immature or unavailable, there are still issues on the package of training and the population coverage. Trauma varies in type, severity, and complexity of management. Even with good training on basic life support to laypersons, it would be difficult to major life threatening injuries such as those involving head, pelvis, and multiple viscera. Another limitation is that such training of skills requires practical session which may not be that feasible to a big group of learners (population). Furthermore, basic tools and equipment necessary for evacuation, first aid, and transportation of injured person are normally not readily available to complement the acquired knowledge and skills. For this reason, there ought to be a political will to facilitate not only the acquisition of basic knowledge and skills to manage a trauma victim, but also sustainable provision of basic tools for such a task. One useful approach would be inclusion of such information and skills training in school curriculums simultaneously with provision of practical tools. This will to create awareness and orient children with skills for safe handling of an injured person at basic level. This also means that

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elementary school teachers and school environment will be equipped to deliver such education and skills. There are other opportunities in LMICs to train laypersons on this regard. For example, women cell groups, village community banking (VICOBA) meetings, and faith based gatherings such as churches and mosques. However, as civilian services are hardly standardized and rarely sustainable, LMIC governments should be encouraged to plan for paramedic services which will ensure that a seriously injured person is handled by a well trained personnel from incident scene.

5. Consequences of trauma to rural and semi-urban regions of the LMICs

Rural and semi-urban regions of the LMICs are predominantly inhabited by the poorest of the world population. In general terms, poverty instigates risky activities and poor environmental and occupational safety standards leading to trauma and the resulting disability is also associated to future poverty, hence a vicious cycle [59]. For this reason, any financial-demanding preventive, curative, or rehabilitative strategies against trauma and its consequences are severely limited. Although there is scarcity of reports on trauma-related health costs from LMICs, it is generally apprehended that such cost is unbearably high to this population [59, 60]. Consequently, persons who sustains trauma in these regions either dies (before or immediately on arriving to the health facility) due to a lack of emergency and life support services or remains with irreversible disability. It is "lucky" for a seriously injured person from these regions to survive without any residual significant impairment. Inadequacy in evacuation, transportation, and timely management of trauma casualties are factors prehospital mortality, secondary injury, and disability which could otherwise have been avoided.

The cost associated with trauma-related disability in these regions is rarely researched, but it is an irrefutable fact that they are common and costly in these regions. Reporting in the bulletin of the World Health Organization, Gosselin and colleagues refers to injuries as a neglected burden in LMICs [60]. It is indeed forgotten as very few projects on trauma are carried out and or published from these regions. When matched against country-specific gross domestic product (GDP) trauma in the rural and semi-urban regions of the LMICs are astronomically costly. It is estimated that most countries in the LMICs spend between 1.1 and 2.9 of their Gross Domestic Product (GDP) to trauma due to RTAs alone [61, 62]. In Thailand, it was estimated that for 10 years, more than 5 billion dollars had been used due to RTAs-related trauma [63]. Trauma also induces a significant straining on the already resource-constrained health system individual and immediate family.

In these regions, there are hardly any published estimates of social costs due to trauma including those resulting from other causes such as falls, burn, and assaults. However, it is known that most developing countries lack basic social security system from which a person who incurs trauma can be supported to attain healthcare and rehabilitation services accordingly. This means that the whole treatment cost for someone with significant trauma is left to the individual and immediate family. It follows that if the injured person and immediate family

are financially unstable there is a failure in affording necessary health and rehabilitation services. Even in countries where there may be exemption (after thorough social assessment) for persons who cannot afford hospital bill, the challenge remains on getting to and being admitted in such hospital in the first place. A recent study in Uganda reported that among the difficulties faced by individuals with trauma included inability to attain and afford transport to the hospital and pay for treatments. For this reason, they had to rely on social support from close relatives and friends [64].

Injuries resulting from traumatic forces may recover fully or leave the individual with either a temporary or permanent disability. Of these three possible outcomes, permanent disability is most costly to the individual and immediate family. This cost is due to the fact that persons with permanent disability require health-sustaining and rehabilitation services including assistive devices throughout life. Such devices are necessary for them to carry out activities of daily living, pursue a career, and engage in their communities. Essential assistive devices range from relatively affordable hand sprints (for activities of daily living) to more expensive wheelchairs which are a prerequisite for mobility and function. Majority of individuals with severely lower limbs impairments such as total paralysis are left with no other means of mobility except a wheelchair. Unfortunately, essential assistive devices are either unavailable or unaffordable in most rural and semi-urban inhabitants of the LMICs. Again, the burden affording assistive devices is also left to the person and/or immediate family who (in most cases) cannot cover the entailed cost [65]. As a result, a majority of disabled persons lack assistive devices or obtain inappropriate one as a donation. Lacking appropriate functional and mobility device leaves the disabled person in a state of dependence in various aspects. Dependence that results from lack of assistive devices adds to the perceived severity of disability [66]. This disability culminates poverty to the person and affects the whole family particularly the dependents.

6. Conclusions

Rural and semi-urban regions of LMICs are predominantly characterized by numerous cultural, socioeconomic, and environmental factors for physical trauma. Existence of such factors sets the inhabitants of these regions at higher risk of physical trauma than those living in the city and high income countries. RTAs are the leading cause of trauma in most of these regions as a result of overcrowding of four-, three-, and two-wheeled motorized and nonmotorized vehicles and pedestrians in limited road spaces. Added factors for RTAs in these regions are: common drunk-driving and speeding behavior and infrastructure deficiencies such as lack of road lights and signs. Fall from trees and other falls (including falling with a load on the head) are other significant causes of physical trauma in these regions. Uniquely, these falls are precipitated crucial and necessary socioeconomic and cultural activities of the people making it complex to reduce incidents of tree climbing. Children sustain not only burn injuries, but are also common victims of fall from trees.

The majority of persons who sustain trauma in these regions are haphazardly handled and transported to health facility by laypersons hence increasing risk of secondary trauma and prehospital death. Evacuation, transport to health facility, management, and future rehabilitation

of permanent disability is the end outcome is very costly. Such cost is incurred by the injured individual with his or her immediate family. There are also continuous disability-related health and rehabilitation cost such as function and mobility assistive devices which are also left to families to meet. Being a poor setting, most disabled persons and their families struggle to meet the entailed cost. As a result, a majority of disabled persons in these regions lack appropriate devices to enable their functioning. As a result, they end up being almost always dependent on others socioeconomically and in activities of daily living. This state lowers the quality of life and increases poverty levels to persons with disability and their families.

Author details

Haleluya Imanueli Moshi[1,2]*

*Address all correspondence to: luluwayesu@gmail.com

1 Kilimanjaro Christian Medical Center, Faculty of Rehabilitation Medicine – Physiotherapy, Moshi, Tanzania

2 Faculty of Medicine, Department of Community Medicine and Rehabilitation – Physiotherapy, Umea University, Sweden

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Section 4

The Military and Global Health

Chapter 6

The Impact of National Militaries on Global Health

Kip R. Thompson

Additional information is available at the end of the chapter

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Abstract

Historically, the movement of military personnel has had serious consequences on global health. From the decimation of native people in the western hemisphere through the introduction of smallpox to the cholera epidemic in Haiti, militaries and military operations have served to spread disease and facilitate the emergence or re-emergence of novel disease organisms. This chapter provides historical insight into these impacts and reviews the impacts of more recent military activities, especially, recent military operations, on the global burden of disease and health to include vector borne disease, infectious diseases, and emerging diseases across the globe. Emphasis will be placed on current military operations.

Keywords: military, disease, emerging disease, infectious, vector, tick, mosquito, sand fly, yellow fever, malaria

1. Introduction

Throughout early human history, people were relatively isolated from each other due to an inability to move large numbers of people large distances. This isolation precluded the importation of flora and fauna, including those which cause human disease [1]. However, as technology improved and population numbers increased, populations began to move, which resulted in the movement of regional diseases to non-endemic areas. Prior to this, the spread of disease was limited by how fast people could walk or beasts of burden such as oxen and horses could move. The unintended outcomes of this increased movement of people included an expansion of infectious diseases, movement of vectors to new areas and a subsequent importation of these related vector-borne diseases. Well known examples of this movement of disease includes the movement of the Black Death or plague from city to city in late 1300's, which killed an estimated

75 to 200 million people across Europe [2], the importation of smallpox to the America's in the fifteenth through nineteenth centuries [3] and cholera transported to the Baltics, Mexico and the United States by troops, ships and immigrants in the 1830's [4]. Examples of vector and vector borne-disease invasions facilitated by the movement of people include species of the *Aedes* mosquito, to include *Aedes aegypti* thought to have been brought to the Americas during the slave trade [5] and which is the primary vector of the recently introduced Zika virus in the western hemisphere, and *Aedes albopictus*, a competent vector of arboviruses such as West Nile virus, dengue and yellow fever, thought to have been introduced to the New World since 1930, and *Anopheles* species to include *Anopheles gambiae* which was the vector responsible for importing *Plasmodium falciparum* malaria from West Africa to South America in 1930 [4]. All are thought to have been brought from Africa and Asia to the Americas through the transport of goods and people by ships and airplanes. More recent examples include the introduction of the East Asian tick to New Jersey in the eastern United States [6].

Another aspect of increased mobilization is the speed at which diseases can be spread. While the speed of spread may be affected by the causative agent, there is no doubt mass global transport may increase the pace at which diseases can be spread. For example, the 1957 influenza pandemic which originated in China was able to spread from its epicenter to a global distribution within 6 months due to regular air travel across the globe [7]. Similarly, severe acute respiratory syndrome (SARS), a disease caused by a coronavirus, was able to spread from a single source in southern China to people in 26 different countries within the course of 3 months [8]. Intense monitoring and isolation of infected individuals may have reduced the transmission and avoided another large-scale pandemic. While both influenza and SARS are respiratory infections, the global spread of other types of diseases has been shown to have been facilitated by mass global transportation. One such disease is the Human Immunodeficiency Virus (HIV) and its associated disease Acquired Immune Deficiency Syndrome (AIDS). While genetic analyses indicate that HIV made the jump from chimpanzees to humans approximately 70 years ago [9] in western Africa, the disease started to spread in the 1970's and 1980's due to travel, especially of certain groups such as immigrants, mass goods transporters and military personnel. While the majority of HIV positive individuals still live in Africa, by 2016, an estimated 36.7 million people across 125 different countries were HIV positive. Due to movement of peoples, the disease increased from an estimated 10,000 to 300,000 cases to 36.7 million cases in only 35 years [10].

2. Historical impacts of military operations

While the preceding examples are broadly based and were influenced by the general movement of people and goods, military operations have directly or indirectly influenced the regional and global spread of diseases. When militaries invade new areas, they are exposed to new ecological habits, tend to cause the displacement of people including civilians and military personnel, and modify the local infrastructure, which may promote disease or disease re-emergence. For example, during the Siege of Caffa in 1346, members of the Mongol Tartar Army are thought to have introduced plague to the residents of Caffa, either intentionally

by the hurling of plague infected bodies over the walls, or unintentionally through rodent to rodent transmission. Infected residents and military personnel fleeing the city by boat are thought to have transmitted the disease to Mediterranean ports, where it rapidly spread throughout western Europe [11]. Evidence indicates smallpox was also instrumental in affecting outcomes during military campaigns in the New World. For example, because of the decimation of the native people due to the introduction of smallpox by the Spanish, Hernan Cortes was able to conquer the Aztec Empire and much of modern Mexico. Similarly, during the Pontiac Rebellion and the siege of Fort Pitt, Field Marshall Amherst and Colonel Henry Bouquet of the British Army are thought to have used smallpox inoculated goods such as blankets to transmit smallpox to the Native Americans to expatriate them from the territory [12]. While impossible to prove, this act and the incidental exposure of Native Americans in the area to smallpox may have been responsible for the deaths of up to 1.5 million people [13].

Other diseases, while not used to fight a war, have impacted the outcome of wars or even been used as a reason to start wars. The British defeat at the Battle of Cartagena in 1741 by the Spanish is thought to have been facilitated by the substantial loss of British sailors and troops to disease, particularly yellow fever. The British also lost a substantial number of soldiers to yellow fever during their peaceful occupation of Havana, Cuba during the Seven Years War, losing more men than they did in operations in North America during the same time [14]. Other armies were not immune to the impacts of yellow fever. From 1801 to 1803, Napoleon's largest expeditionary force was destroyed by yellow fever during the Haitian-French War, with over half of the deaths caused by yellow fever [15]. Beginning in 1894, the southern US began to experience an outbreak of yellow fever. The source was thought to be Cuban immigrants and fishermen operating in US waters. US government officials sought to curb the outbreak in the US by sending epidemiologists to Cuba to try and reduce a concurrent outbreak in Cuba. When the outbreak continued, the US officials approached Spain to address the outbreak. However, the Spanish response was to quash a rebellion occurring in Cuba at the time, increasing the cases of yellow fever. As a pretext to stop the outbreak, on April 25, 1898, the United States declared war on Spain. In the lead up to the war, US trainees located in camps in the southern US also contracted yellow fever, seriously impacting the US's ability to wage war. By 1900, US researchers had determined yellow fever was caused by the bite of a mosquito and by 1901, yellow fever had been eradicated from Cuba [16].

During the early part of the twentieth century, influenza was the primary disease influenced by the massive movement of people. The primary factor driving this mass movement of people was World War I. From July 1914 to November 1918, more than 70 million military personnel were mobilized in support of the war effort [17]. During this time, a new strain of the influenza virus, H1N1, began to circulate among troops in Europe and was carried across the globe as troops moved from Europe back to their home countries. The disease spread rapidly through militaries, especially among camps found across the United States. At its height, the admission rates among these camps was 361 per 1000 individuals. This infection of training camps provided a ready source of movement of the virus back to Europe as troops moved back and forth [18]. At the height of the infection, over 500 million people were infected globally, and 50 to 100 million people died, resulting in a global reduction in life expectancy of over 10 years [4].

3. Current military operations and emerging infectious diseases

In more modern times, military operations have resulted in the expansion in the geographic distribution of many diseases, including those of concern at the turn of the twentieth century. This includes influenza, cholera and other diseases of historical importance. Additionally, these military operations have expanded the geographic distribution of diseases either thought to have been eradicated in a region or the emergence of novel diseases. These diseases can be compartmentalized into vector borne diseases and infectious diseases.

3.1. Vector borne diseases

Vector borne diseases are those diseases which are transmitted when a person is bitten by an infected arthropod vector. These diseases are typically broken up into those transmitted by a mosquito, a tick or a fly, especially species of sand flies. Until World War I, the main cause of morbidity and mortality in military populations was infectious disease, not battle wounds. This trend reappeared during the Vietnam War. Among the main causes of disease were those caused by vectors, especially for diseases such as plague, yellow fever, malaria, louse borne typhus and louse borne relapsing fever [19].

3.2. Mosquito borne

Mosquito borne diseases can be caused by various agents such as viruses or protozoans. Historically, diseases such as malaria and yellow fever have negatively impacted military operations. Military personnel returning to the US from European, African and the Pacific theaters after World War II are thought to have drastically increased the incidence of malaria in the US [15]. By the end of the decade after the war, malaria was eradicated from the US, with the country being certified malaria free in 1969 [15]. Even though malaria was eradicated in the US, during the Korean War, military personnel returning from the conflict to the United States are thought to have imported malaria back to the US. For example, in 1952, Camp Fire girls attending summer camp in California contracted *Plasmodium vivax* brought to the region by returning Korean veterans. This was possible because of the latency period of *P. vivax*, which can approach 1 year in duration. Importation during this period caused the incidence of malaria to spike in the US, reaching a high of 7023 cases in 1952 [20]. This importation of malaria to the US by returning military personnel also occurred during the Vietnam War. From 1965 to 1968, the incidence of malaria increased in the US from 50 cases to a high of 2610 in 1968. Most of these cases were in US military personnel but in 1967, the number of civilian cases peaked at 157, an increase of 119 in only 8 years. At least once case of malaria was reported from each state during this time frame [21]. More recently, from 1981 through 1989, malaria was re-imported into the former USSR by troops returning from fighting in Afghanistan. During this period, over 7000 cases of malaria were reported in the USSR in personnel returning from the war. All cases were caused by *Plasmodium falciparum* and *P. vivax*, which were thought to have been eradicated in the USSR prior to the conflict. This importation of malaria caused the incidence to rise in the overall population, with cases reaching at least 420,000 in 1985 [22]. Finally, from

2003 to 2005, 423 US military personnel contracted malaria while deployed to the demilitarized zone (DMZ) in South Korea. The cases were primarily caused by *P. vivax*, however, approximately 20% of the cases were caused by *P. falciparum*. Additionally, cases were reported in military personnel deployed to Afghanistan, Liberia and Honduras. Of importance is the fact that within 45% of those diagnosed with malaria, the diagnosis occurred more than 240 days after the mid-point of their service in Korea [23]. This implies that these military personnel could serve as reservoirs to import malaria to the US or other countries to which they may be deployed. This is important because malaria has been considered eradicated from the United States, although the primary vector, Anopheles mosquitos, still occur, indicating that the movement of US military personnel around the globe could act as a method of reintroduction of malaria, much like happened in the USSR.

While it has been shown that malaria can and has been imported and reintroduced through military operations, it is by no means the only mosquito borne disease impacted by the global movement of military personnel. Once such disease is dengue and dengue hemorrhagic fever, both transmitted by several species of the *Aedes* mosquito type, primarily *Aedes aegypti* [24]. Historically, dengue has caused major illness in military personnel. Dengue was present in US troops in the Spanish-American War, during the conflict in Cuba to contain yellow fever, during World War II, the Vietnam War and during operations in Somalia. Troop movements during the conflict in Cuba are thought to have led to an outbreak of dengue in Texas as troops returned to the US from Cuba, resulting in over 6000 people being infected [25]. In the Philippines, dengue was second only to venereal diseases as the most common illness in US personnel stationed there at the start of the twentieth century [26]. During Operation Restore Hope in Somalia in 1992–1993, US personnel were shown to have contracted dengue, with 45% of those with an undefined fever having confirmed dengue through seroepidemiologic confirmation [27]. More recently, US personnel deployed to Haiti testing positive for dengue fever accounted for 25% of all hospital admissions within the first 6 weeks of the deployment [28]. While no recent cases of dengue in the US have been shown to have occurred because of the movement of military personnel, an outbreak of dengue in Australian troops during operations in East Timor highlighted the possibility for returning military personnel to import dengue to areas where it has been eradicated. During retrograde operations from East Timor, nine Australian military personnel were confirmed positive for dengue after their return to north Queensland. While no local transmission cases occurred, the potential for importation is possible due to the mosquito vectors being present. This is also true in the US, where species of *Aedes* mosquitoes are common throughout much of the US [29].

Other mosquito borne diseases shown to have the potential for importation by military personnel include chikungunya, West Nile and Rift Valley virus and lymphatic filariasis. A new variant of chikungunya has been shown to have been introduced to temperate regions such as the US, possibly by troop movements. This is important because this variant is associated with a new vector, *Aedes albopictus*, which possibly has a more cosmopolitan distribution that *Aedes aegypti*, the more common vector of chikungunya. Additionally, serological evidence supports the importation of lymphatic filariasis to Australia by an Australian soldier stationed in Timor [15]. These incidences highlight the potential for military personnel to import many mosquito borne diseases across the globe.

3.3. Tick borne

Ticks are ectoparasites, meaning they feed on their hosts on the skin or body surface. They are known to be vectors for several viral and bacterial diseases including ehrlichiosis, tularemia, Rocky Mountain spotted fever, Lyme disease and many others [15]. Military personnel are at a high risk for tick borne diseases because of their increased time in rural, remote areas due to training and combat operations. For example, 11.9% of recruits in the Finnish Army were shown to be positive for antibodies against *Borrelia burgdorferi*, the causative agent of Lyme disease, while US armed forces show exposure exceeding those in the general US population [15]. The same outcomes occur for spotted fevers. During a training exercise in 1989 located in Arkansas and Virginia in the US, 15% of military personnel tested positive for *Rickettsia rickettsii*, the causative agent for Rocky Mountain spotted fever. These cases occurred in troops from states where the disease was not found, indicating they were novel cases which had the potential to be carried back to the home states of the military personnel if not diagnosed and treated [15]. If ticks capable of being a competent vector occur in those states, the geographic range of the disease would be increased. The same disease has been shown to be common in British military personnel deployed to Afghanistan with as many as 4.9% seroconverting for exposure to *Rickettsia* spp. and 2.7% converting after their deployment to Afghanistan. This implies that it may be possible for these personnel to carry the disease to the United Kingdom [30].

Ticks are also the primary vector for Crimean-Congo hemorrhagic fever (CCHF), a disease caused by an arbovirus in the *Bunyaviridae* family. CCHF is spread from host mammals such as rodents and small mammals to humans through the bite of *Hyalomma* tick species [31]. CCHF has been shown to be present in Afghanistan, where military operations, led by the North Atlantic Treaty Organization (NATO), have been occurring since 2003, where the risk for CCHF exposure is high. US military personnel deployed to Afghanistan are at risk for contracting CCHF, with one US military member contracting the disease in Afghanistan, which ultimately led to his death [30]. Evidence exists which indicates CCHF can be imported to new geographic regions via the movement of individuals coming from areas endemic for the disease. In 2012, health care providers in the United Kingdom confirmed a case of CCHF in an individual returning from Afghanistan [32]. Because *Hyalomma* ticks are common across Europe, introduction of the arbovirus by military personnel and an expansion of the geographic distribution of the disease are of potential concern to public health organizations.

3.4. Sand flies

Sand flies include species of flies found in several different Genera. Of concern are those of the Genera *Phlebotomus* and *Lutzomyia*, both of which can transmit the parasites of the *Leishmania* type [15]. This parasite is responsible for leishmaniasis, a disease with two main forms in humans, cutaneous and visceral. As an emerging vector borne disease, much research into the life history, distribution and potential for range expansion has been conducted regarding the vector, the sand fly [33]. Sand flies are crepuscular, with the highest infection rates occurring at dusk and dawn [34]. The organisms responsible for causing leishmaniasis are found in over 90 countries, including those with current military activity. Of note are military operations occurring in Afghanistan and formerly in Iraq [34] where genetic sequencing has confirmed the

parasite in areas where NATO troops are operating [35]. Rates of infection in military personnel can be high. During operations in Afghanistan and Iraq, it is estimated that at least 1300 US military personnel have contracted leishmaniasis [36], an incidence higher than that seen in US military personnel in World War II [34]. British, Dutch and German forces have also experienced leishmania infections while deployed to Afghanistan [15]. Additionally, 45% of all cases of leishmaniasis seen in the United Kingdom in 2011 were in British military personnel who had conducted training in Belize [37]. Little research has been conducted on the capacity for sand fly species in non-endemic areas to transmit the disease, however, Claborn et al. were able to show that species of sand flies in the genus *Lutzomyia* found in the US may be capable of serving as vectors for Old World, temperate adapted species of *Leishmania* types [36]. This implies that military personnel could serve as a reservoir to expand the geographic range of Old World types to the New World if endemic sand flies received the parasite from an infected individual.

Sand flies are also competent vectors for an arboviral infection caused by serotypes of the Phlebovirus. This infection, often called sand fly fever or pappataci, is considered a disease of military importance, affecting military personnel deployed to the Middle East and the Mediterranean. During World War II, sand fly fever was of serious concern to allied forces, with over 19,000 cases reported. Outbreaks have been reported in allied forces deployed to Afghanistan, although at numbers far fewer than for leishmaniasis [15]. Of British military personnel deployed to Afghanistan, only 4.8% were shown to have seroconverted. However, local populations show high rates of seroconversion, indicating the risk to military personnel operating in these areas, and the subsequent risk of importation to other countries remains high [15].

3.5. Infectious disease

In the context of this discussion, infectious diseases are those that are spread by means other than vectors. These can include emerging infectious diseases, which are those that are entirely new to a population or geographic region or that have been re-introduced. The conditions that favor this emergence are often encountered during military conflict, increasing the risk of the disease not only to the civilian populace, but to military personnel mobilized to these areas. The emergence of these infectious diseases can often be a two-way street, meaning military personnel may bring diseases with them or local diseases may be transported by military personnel to their home countries or regions. For example, Lassa fever, an often-fatal viral disease, was imported to Germany from Sierra Leone in 2006 while a case was imported to the US from Liberia in 2004. Additionally, cases were imported to the Netherlands in 2000 and the United Kingdom in 2003 by military personnel returning from peace keeping missions. In both countries, war had displaced large numbers of people with aid workers and military personnel moving in and out on a regular basis [38].

3.6. Respiratory diseases

Influenza remains a disease of serious concern for military personnel. As militaries from various countries are mobilized to more and more places, the risks of an influenza pandemic increase. Even with higher vaccination rates, military personnel show high rates of infection and seroconversion. For example, in 2011, 30.1% of US military personnel seroconverted for

influenza, even though the US Department of Defense requires mandatory vaccination of all military personnel. A new variant of influenza (H3N2 A/Wuhan) was the primary causative agent for an acute outbreak of influenza aboard a US Navy vessel in 1995–1996. During the outbreak, over 95% of the crew had received the influenza vaccine for that year. Even with this high vaccination rate, 232 crew members contracted the flu. The source of the outbreak was a single sailor who had vacationed in North Carolina prior to the ship sailing [39]. Even with high vaccination rates, the high rate of infection occurred because of the new variant of the virus which was not included in the vaccine. This underscores the capability of highly mobile military personnel to serve as conduits for a rapid spread of novel diseases. This potential for rapid expansion and emergence of novel strains was apparent in 1976 when a Private David Lewis died of influenza while training at Fort Dix, New Jersey. Post mortem examinations revealed he had died from a novel strain of swine flu, prompting the Centers for Disease Control and Prevention and the President of the United States, Gerald Ford, to declare an emergency and mandate a 100% vaccination rate. Ultimately, an epidemic did not occur, however it highlighted the potential for a new global influenza pandemic [40].

Other respiratory diseases shown to be capable of mobilization and transmission by military personnel include pneumonia, pharyngitis and acute rheumatic fever, pertussis and tuberculosis. Of grave concern is the appearance of bacterial resistant strains of the causative agents for these diseases. Many of these strains are not endemic to the country of origin for the military personnel. For examples, *Streptococcus pneumoniae* epidemics in military personnel became rare by the 1980's, due to the use of antibiotics in treatment. However, multi-drug resistant strains reported in civilian populations globally have caused outbreaks among US military personnel. The rate of drug resistant forms has increased to over 70% in Korea, with US military personnel and their families contracting these strains. Additionally, US ship's crews in the Mediterranean have experienced outbreaks of resistant pneumonia while operating off the coast of Italy [41]. Increases in the prevalence of resistant *Streptococcus pyogenes* have also been noted in US military personnel, even though these strains typically only occur in Europe and Japan, both regions with an active US military presence [41]. These strains are rare in US civilian populations but may be introduced by military personnel if not actively monitored and controlled. In 1997, Fort Jackson, South Carolina experienced an outbreak of adenovirus type-4 among its basic trainees. Because graduating basic trainees typically move directly from basic training to their advanced schools at other installations, they may serve as a conduit for disease expansion. One such graduate from Ft. Jackson was shipped to Fort Gordon, Georgia. Because of an unusually long incubation period of 58 days, this graduate introduced adenovirus type-4 to Ft. Gordon, which then experienced its own installation wide outbreak [42]. This example highlights the ability of military personnel to transfer infectious diseases from location to location and introduce it to the local population. Alternatively, French soldiers typically do not receive vaccinations against *Bordella pertussis* as an adult. While deployed in support of International Security Assistance Forces in Afghanistan in 2006 and 2007, French soldiers were exposed to the pertussis bacteria. By the end of the pertussis outbreak, the cumulative attack rate among French soldiers reached 20%, illustrating the potential for military personnel from other countries to be exposed to novel infectious agents, especially when they have no native resistance to the causative agent [43]. Because of its public health significance, tuberculosis remains a global disease of concern as multi-drug

resistant strains have developed in many parts of the world [44]. Military activities, due to their cramped living and operating conditions, provide a prime habitat for TB outbreaks to occur. Additionally, because military personnel, especially naval personnel, are often exposed to novel or resistant strains while in contact with the resident population where they embark, they are at risk for contracting and spreading TB. In 1987, the seroconversion rate for the crew of the USS Saipan was 24.5% [45], which was a decrease from the 48% seroconversion rate of the USS Richard Byrd in 1966. Because of these declining seroconversion rates, it was thought that adequate control measures had been developed, mitigating the risk of TB on ships. However, in 1998, the US Navy experienced an outbreak of TB aboard a large Navy amphibious ship. Of the approximately 1000 crew members on board, 21 members developed active TB and 447 were positive for the Mantoux tuberculin skin test (TST). All were thought to be new cases [45]. A second outbreak occurred in 2006 aboard the aircraft carrier, USS Ronald Reagan. During this outbreak, a sailor born in the Republic of the Philippines, who was diagnosed with latent tuberculosis infection (LTBI), converted to active TB. Of the approximately 4000 personnel on the ship, 134 had a new TST result, most likely from the recent transmission of tuberculosis from the index case [46]. Additionally, over 1300 civilians were allowed on the ship as it returned to its home port in San Diego, California. Of these, only one exhibited a new positive result. Of more importance, the Navy was unable to locate 33 sailors who may have been exposed due to separation from the Navy. In this instance, the ultimate source of the outbreak was a foreign-born sailor who converted to active TB, meaning the source of the bacteria was not the US, although US personnel potentially brought the strain back to the US.

3.7. Gastrointestinal disorders

While respiratory diseases are of major concern, diseases of the gut and intestines may occur at a much greater incidence. Diseases such as norovirus, salmonella, *E. coli* and others are the second most leading cause of global disease burden [47]. Historically, diseases such as cholera, dysentery and typhoid, caused by *Salmonella enterica*, have caused serious disease morbidity and mortality for military personnel, often by transmission from the local environment to incoming military personnel. However, these diseases have also moved among these same personnel. For example, during the Spanish-American War of 1898, typhoid affected more than 24,000 US military personnel training at camps in preparation for mobilization. This outbreak was used by MAJ Walter Reed to determine the origin of typhoid in the camps and the development of controls to reduce its impact on military operations [48].

Many of the causative agents, especially bacterial agents, are showing resistance to antimicrobial therapy [49]. This resistivity varies geographically, as does the primary causative agent. In the US and other parts of the world, ETEC or enterotoxigenic *Escherichia coli* accounts for the majority of traveler's diarrhea. However, in Thailand, the primary agent is *Campylobacter* species. Of note is the resistance of this particular strain to quinolones and other antibiotics in Thailand. Military personnel deployed to in Thailand in 1987 and 1990 showed resistance up to 11% of the time, resulting in relapse of the disease. By 1995, resistance had increased to 84%. Because resistance is high, relapse is also high [49]. One potential outcome of this resistance and relapse is the introduction of this novel strain into other parts of the world as deployed personnel return to their country of origin. This has the potential to change the

geographic distribution of this resistant strain of *Campylobacter* from regional to global. Other bacteria responsible for diarrhea have also shown resistance in deployed military personnel. During Operation Desert Storm, US military forces suffered from high rates of gastrointestinal infections. Of 432 US military personnel reporting with gastroenteritis, 17% were found to be infected with antibiotic resistant *E. coli*, 54% of *Shigella sonnei* infections were resistant as were many other causative agents [50].

Other diseases, while not specifically resistant, have shown a propensity for expansion of its geographic distribution through military operations. Cholera was historically contained to the Indian subcontinent but was brought to other areas of the globe through shipping and trade, including the slave trade. However, the first cholera pandemic occurred from 1817 to 1823, caused by the movement of British troops and camp followers in the Indian subcontinent and abroad. A similar pattern occurred during the Crimean War [51]. Asiatic cholera was first introduced to the US by immigrants arriving at seaports. While rare up until the mid-1800s, cholera rapidly expanded in the US, partially by the movement of troops westward. This westward expansion of military forces, and subsequent expansion of cholera, resulted in outbreaks among civilian populations who would not otherwise have been exposed [52]. More recently, humanitarian military operations resulted in the introduction of cholera to an area where it had not been endemic. In 2010, a catastrophic earthquake struck Haiti, effectively destroying its infrastructure. In response, the United Nations mobilized peace keeping forces to aid in security and recovery. By October 2010, Haiti began to see cholera cases appear in the local populace. As of July 2015, almost 750,000 cases of cholera had occurred on Haiti, resulting in almost 9000 deaths [53]. Genotyping of the cholera strain indicate the source was from South Asia, particularly the Bangladesh and Indian subcontinent. During the peacekeeping operations, the United Nations sent military personnel from Nepal to support the operation. Based on the genotyping, and the peacekeepers present, it was concluded that the source of the outbreak was the Nepalese military personnel who had set their camp up along a river bank that served as a source of domestic water for the Haitians [54]. The resulting outbreak was the largest cholera outbreak to ever occur. It was not until December of 2016 that the UN Secretary-General, Ban Ki-Moon, acknowledged the UN's role in the disaster. This episode drastically illustrates the potential for military forces to import diseases to areas where they are deployed and the scope of the potential outcome when this occurs.

3.8. Other bacterial infections

One final note involves organisms that are normally not pathogenic, but have the potential to become so, especially when individuals are exposed to a novel strain. *Acinetobacter baumannii* are common bacteria found in the soil, on skin and other surfaces, particularly artificial surfaces. Recently, *Acinetobacter baumannii* has emerged as an important pathogen in hospital settings, resulting in nosocomial infections in patients with an associated increase in morbidity, morality and health care costs. Since operations began in Iraq, the incidence of infection by *Acinetobacter baumannii* in US military personnel has increased [55]. While *Acinetobacter baumannii* is not unique to Iraq or Afghanistan, multi-drug resistant forms, until recently, were relatively rare in the US [56]. Molecular genotyping of the multidrug resistant forms found on US personnel, indicate a subtype found in the Middle East as the primary infectious agent

in wounds sustained in combat operations in the region. Because *Acinetobacter baumannii* survive extended periods of up to 4 months, medical devices may be a source for nosocomial infections [57]. Similar patterns of initial and nosocomial infection have been seen in United Kingdom military personnel injured in Iraq and Afghanistan. The most common strain found in wounded personnel of the US and the UK is isolates of the T strain. This strain is associated with the Middle East, particularly Iraq [58]. The movement of these military patients has resulted in the international transfer of multidrug resistant *Acinetobacter baumannii* strains into other European countries as well as into the US [59]. These same strains are now found in the US. Similar strains have been independently found in injured soldiers being returned to Canada. This is significant because in Canada, unlike in the US, military wounded are cared for in civilian hospitals, not military hospitals. This increases the risk of the T strain of *Acinetobacter baumannii* becoming established in the civilian health care system in Canada, thereby increasing the risk for nosocomial infections [60].

4. Conclusions

The introduction of novel diseases is a hot topic not only in the United States, but also in Europe, South America and globally [61]. This has become more important as these diseases have re-emerged and spread. Within the last 20 years alone, the increased number of military operations has resulted in a marked increase in the movement of personnel and equipment. As military forces are increasingly mobilized globally in combat and peace keeping roles, the risks of increasing the distribution of emerging infectious diseases will also increase. Detection and control of these emerging diseases will be a major challenge, not only for those countries where military operations are occurring, but also in the countries providing personnel and equipment for these operations [38]. As the disruption of impacted societies increases due to military operations, it is reasonable to expect the emergence or re-emergence of diseases will increase. While increasing military deployments and operations may increase the risk and rate of the spread of infections and emerging diseases, these same militaries can improve surveillance by partnering with local governments and officials to improve their capacity and capabilities. These mutual engagements could potentially reduce the time for detection of an epidemic of global significance. While detection and control of emerging disease is the major challenge facing humans today, partnered engagements may serve to reduce the risk. Going forward, militaries may need to expand their role in post-disaster assistance, surveillance and other activities that could possibly expand the public health capacity of the civilian populations.

Author details

Kip R. Thompson

Address all correspondence to: kiprthompson@missouristate.edu

Master of Public Health Program, Missouri State University, Springfield, Missouri, USA

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Current Issues in Global Health provides a forum for a broad discussion of health issues, from systemic violence to infectious disease in places as far apart as Kashmir and South America. The authors come from a variety of environments including military and academic positions. Despite the diversity of subject matter and authors, the consistent theme of the book always focuses on the provision of an environment in which members of a community can achieve or maintain good public health. The subjects addressed here are those that cross international borders and affect lives around the world, thus truly qualifying as issues of global health importance.

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