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Madagascar: Transitions in health care

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PREFACE

In January 2011, after I found out I was accepted to study abroad in Madagascar, I spent the rest of the semester conducting research to support my thesis proposal. As the semester progressed, my thesis statement developed into the following: "As the health care system is being transformed from traditional to modern health care in the country of Madagascar, the traditional aspect of health care needs to be heavily incorporated in the transition. In this way, efficacy can be maximized and the cultural practices can be protected." My research suggested that traditional medicine was the main vehicle of health care in Madagascar; I predicted that the poverty of the Malagasy people might have been partially due to the fact that biomedicine had not yet been properly introduced to the country. I argued that as biomedicine is disseminated across the globe, especially to countries with a lack of modern facilities, it is important to include the country's traditional concept of medicine to make the transition more effective. The approach must be sensitive towards the attitudes of the native culture; at the same time, the approach must avoid paternalism to the end of respecting the culture's customs and dignity.

Soon after arriving in Madagascar, I realized that I had underestimated the extent to which biomedicine was already present in the country. In fact, the British and French had introduced biomedicine to the Malagasy people as early as the 19th century. As I visited and interviewed traditional healers, toured biomedical hospitals, and lived in solidarity with Malagasy families, I learned that the problem was not that biomedicine had not yet been introduced, but that most Malagasy families do not have access to or

cannot afford clean drinking water, let alone prescription medication or biomedical services. I quickly learned that the opposite of my thesis from my proposal seemed to be the case in Madagascar.

Although the primary research gave me basic knowledge concerning what the Malagasy health care system looked like, the experiential learning offered a clearer, broader, and more humanistic image of the problem. The interactions with professors, the Malagasy college students, and my host families provided context and complicated what I had learned through my primary research. Much of the lecture material, interviews, and first-hand encounters of my study abroad experience formed the basis of the rest of my research once I returned from Madagascar; without these experiences, my thesis would not be what it is today.

ACKNOWLEDGEMENTS

I would like to sincerely thank my advisor, Dr. Marie-Dominique Franco, and my reader, Professor Christine Finn, for all of their patience, knowledge, and advice throughout the entire thesis process. Without their help and support, my thesis would not be what it is today. I would also like to thank Mr. Nat Quansah and all of the professors and lecturers from SIT Study Abroad, the University of Antananarivo, CNARP, SOTRAMEX, and the Madagascar Ministry of Health who shared their knowledge with me in Madagascar. I would especially like to acknowledge the time and experiences shared by the traditional healers whom I interviewed; these men and women provided me with information I could have only encountered first-handedly.

My fellow American class mates during study abroad and the pharmacology students from the University of Antananarivo were instrumental not only in the development of my thesis, but in development of new friendships, as well. The discussions held about our experiences in Madagascar, their topics for their ISP reports, and the questions they brought forth during interviews with traditional healers greatly influenced the progression of my thesis.

I would also like to thank Mary Cook and Lynn Montrose, as well as my French professors Fawzia Ahmad and Dr. Deborah Gaensbauer, for encouraging me to pursue study abroad options. I truly value their support and approachability regarding the stressful process of applying to study abroad and then preparing me for the language

experience once I was accepted; their support and friendships continue through to today. Martin Garnar and Jan Loechell Turner were instrumental in my research, both before and after my experience in Madagascar. Martin Garnar was extremely helpful by adding to the works in the library regarding Madagascar and its history.

Finally, I would like to thank Dr. Tom Bowie and Dr. Tom Howe for their continual support throughout the four years I have been at Regis and in the Honors program. The invaluable lessons of liberal arts and the integration of multiple disciplines have had a great influence on my academic career, and really pushed me towards pursuing a French minor in addition to my Biology major. Although I did not realize it when I started researching Malagasy health care systems, I discovered that the integrative health care system is an appropriate reflection of the liberal arts values instilled in me through the Honors Program, striving to employ the strengths of the two types of health care systems for the betterment – indeed, the *cura personalis* – of the Malagasy people.

I. INTRODUCTION

Ever since the island country of Madagascar separated from the Indian sub-continent approximately 88 million years ago, it has existed in a highly isolated state. Four hundred kilometers to the west, across the Mozambique Channel, is continental Africa; Austronesia is 6,000 kilometers away to the east (Figure 1).

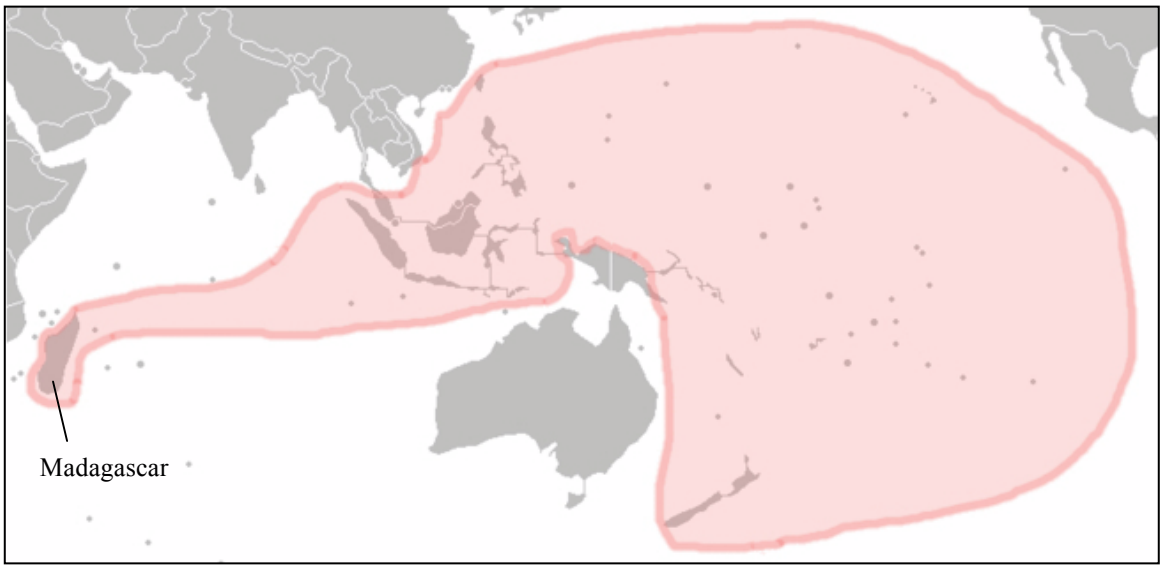

Figure 1. Image of Austronesia; to provide reference for language group and early settlers. Source: http://www.amoeba.com/dynamic-images/blog/Eric_B/Austronesia.jpg

Madagascar, approximately the size of France, is 1,600 kilometers long and 570 kilometers at its widest point (Randrianja & Ellis, 2009). The first human contact is believed to have occurred between 200 and 500 BCE, with populations of travelers settling there permanently around 1100 CE, despite heavy trade route traffic of the Indian Ocean prior to this time. Although Madagascar is spatially closer to Africa, the Malagasy language and cultural features suggest a large Austronesian influence; however, African influences such as Bantu and Swahili are also present. These differences in language and culture represent the diversity of peoples who populated Madagascar, and debatably,

eighteen different ethnic groups made up the country's kingdoms. These ethnic groups, which grew to become more politically-associated than ethnically-based, were present at the time of the first arrival of Europeans in the 1500s. Drawn by missionary, spice trade, and slave trade opportunities, more and more Europeans gained interest in Madagascar. Finally, in the late 18th century, much of Madagascar was ruled by the Merina kingdom, which overtook almost all of the country and became subject to French colonization. King Andrianampoinimerina and his son, Radama I, were the first rulers of this kingdom. Because of the multicultural influence on the foundation of this country, Madagascar's traditional medicine is also as diverse.

After separating from the Indian sub-continent, the flora and fauna of Madagascar were able to evolve in isolation; eighty percent of the plants and animals cannot be found anywhere else in the world. The multitude of diverse plant life further contributed to the traditional medicine of Madagascar. Different environments exist all over the country, from seasonal tropical rainforests of the east, to the exaggerated dry and wet seasons of the west. The number of different types of traditional medicine reflects this ecological diversity, in addition to the multicultural and linguistic influences brought by people of Austronesian, African, and Arabic backgrounds. Each community utilizes the types of plants found in its surroundings to form plant-based medicines, or phytomedicines, which may differ from one part of the country to the next. Each community also has a unique history of traditional medicine, constituting an integral part of Malagasy life, especially before colonization.

According to Dr. Jean Marius Solo Raharinjanahary, former Dean of the Faculté des Lettres et Sciences Humaines at the University of Antananarivo, traditional healers were part of a noble class before colonization by European settlers, often held by Malagasy as wise and religious figures (personal communication, 2011). The Europeans, particularly the French, brought allopathic medicine to Madagascar. European domination caused allopathic medicine to be held in higher respect than traditional medicine, as the French founded the *Institut Vaccinogène*, the *Institut Pasteur*, and an allopathic medical school in the late 19th century. By law, only health professionals who attended this school and received official licenses were allowed to practice, essentially making traditional medicine illegal. However, many Malagasy people still used traditional medicine in their daily lives, at the risk of being denounced (Dr. Jean Marius Solo Raharinjanahary, personal communication, 2011).

The use of traditional medicine by Malagasy people has continued to the present time, and some of the traditional healers who mediate its use have recently been recognized by the Traditional Healer's Association (THA). This group, formed by the Malagasy government, provides certificates for traditional healers who attend training and pay a fee. Within the last year, the Malagasy parliament passed a bill once more legalizing traditional medicine. However, many of the aspects of colonial society that resulted in the lack of recognition of traditional are still largely influential today; traditional medicine has not yet reached its former place in Malagasy society and culture.

The work of some domestic research companies has contributed returning validity to traditional medicine by identifying active compounds in plants used by the healers.

Additionally, clinics providing integrative medicine offer hope to secure the strengths of both traditional and allopathic medicine. I will argue the importance of preserving traditional medicine, which will re-establish the validity of Malagasy traditional medicine, and provide a more affordable health care option for the Malagasy people. A possible solution to preserve traditional medicine in Madagascar may be through the establishment of more integrative medical centers. These centers not only serve to validate traditional healers and their knowledge, but also offer more accessible and affordable care to the Malagasy people, especially in rural areas, where physical and financial access to health care are main reasons behind lack of adequate care.

While Madagascar is rich in its biodiversity, it is at the same time one of the poorest countries in the world. The Madagascar Action Plan (MAP), supported by former president Marc Ravalomanana, enacted goals to foster more respect for the environment, increased quality of the education system, and development in the health sector, family planning, and the fight against HIV/AIDS. These goals were incorporated into Madagascar's poverty reduction strategy from 2007 to 2012 (IMF, 2007). Another poverty reduction strategy, the National Health Sector and Social Protection Development Plan (enacted from 2007-2011), was also developed to address the health care system and improve service delivery standards (Sharp & Kruse, 2011). However, the goals of these plans were disrupted during growing political tensions in 2009, and former President Ravalomanana was actually exiled from Madagascar. A temporary government, not recognized by the international community, was put in place. This political instability has likely induced a negative impact on the country's poverty reduction strategy,

especially because the instability does not make Madagascar a desirable partner in global economic relationships.

However, even with political uncertainties, there has been an increase in investment in Madagascar's health sector, which has been the subject of a number of studies and surveys assessing the state of the health care situation. Although traditional medicine has been acknowledged in the health care sector to some degree, there is still much more investigation to be done regarding its role in the larger context of Madagascar's health care system. This issue especially needs to be addressed because approximately 44 percent of the country is under 15 years of age, and rapid population growth is a recent trend. In fact, Madagascar's population is expected to double from 19.5 million in 2009 to 42.3 million in 2050 (Sharp & Kruse, 2011). Notably, this may be caused by the decrease in infant mortality rates by half within the last ten years; although children are less likely to make it past five years of age, especially in rural areas (Sharp & Kruse, 2011). With more and more individuals surviving through childhood, there will be even more urgency for an affordable form of health care.

Despite growing funds towards the health sector and rapid population growth, the country still suffers from many preventable diseases. The majority of deaths in Madagascar are due to perinatal reasons, diarrhea-related diseases and symptoms, and malaria. Interestingly, the HIV/AIDS prevalence is under one percent nationally, despite the fact that the prevalence of sexually transmitted infections. Sharp and Kruse (2011) report studies showing that the low prevalence of HIV/AIDS might be due to the presence of several different subtypes of the virus appearing on the island, as opposed to

other countries in Africa and Asia in which only one subtype is predominant. On the other hand, Madagascar has some of the highest rates of leprosy, bilharzia (a tropical disease), and the plague out of all African countries and the Indian subcontinent.

With all of the instability associated with the infrastructure of the government and the health care system, it is more important now than ever before to explore what traditional medicine can offer to the struggling health care system. Investigating the strengths of traditional medicine can revalidate Madagascar's culture; improve Madagascar's position in the domestic and international markets in the field of aromatic and medicinal plants; improve equality of distribution of health care facilities and personnel; increase the adequacy and quality of health care services; and markedly improve upon affordability and accessibility for the Malagasy people. Indeed, the increasing validity of Madagascar's traditional medicine can have a positive impact on a wide range of the country's poverty reduction strategies and goals, as well as the government and various aspects of Malagasy society.

II. CHAPTER 1: TRADITIONAL MEDICINE PERSPECTIVES

Experiential Learning: Visiting Traditional Healers

One lesson I soon learned as I began my journey in Madagascar was that there are many types of traditional healers, and many types of traditional medicine. Each of the different types incorporates Madagascar's biodiversity, ancestry, and various religious practices in unique ways. Shamans, *ombiasy*, *mpiskidy*, *mpanandro*, *tromba*, *reninjaza*, and herbalists are different types of traditional healers in Madagascar, and the list is by no means exhaustive (Dr. Randia Narcisse, medical doctor: Centre National de Recherches Pharmaceutiques Appliquées (CNARP), personal communication, 2011). Most of them take advantage of the Madagascar's biodiversity, making plant-based medicine a significant aspect of their practice. During my time in Madagascar, I had several opportunities to visit with and interview traditional healers in the urban setting of the capital city, Antananarivo, and in the rural village of Andasibe (Figure 2).

Among the types of healers my group and I were able to visit were *tromba* and *mpsikidy*. The very first traditional healer we visited practiced *tromba*, a rite of possession in which the healer becomes possessed by an ancestor, who informs the healer of what is wrong with the patient and what needs to be done to heal. *Tromba* might take on different names depending on the region of Madagascar, and people can be possessed by good spirits as well as by bad spirits (Solo Raharinjanahary, personal communication, 2011). This traditional healer we visited was located in the high, rolling hills of Kingory, a small village outside of Antananarivo (Figure 2). Among the hills lay tombs, covered in a slab of rock and surrounded by several other rocks painted white, green, and red,

adorned with zebu skulls. Within these tombs lie prominent or cherished ancestors from the village who provided valuable services to the community; for example, one tomb contained the body of a dentist from the

Figure 2. Map of cities of Madagascar: Morondava, Antananarivo, Moramanga. Andasibe is not shown here, but is just to the east of Moramanga.
http://www.ritimo.org/dossiers_pays/afrique/madagascar/carte%20Madagascar.gif

village, and another contained the body of a zebu herder. The healer informed us that any of these tombs can be used in rituals, depending on the nature of the request; for instance, if a patient is having tooth problems, the healer would perform a ritual at the tomb of the village dentist. The healer led us along a winding trail, and eventually we had to take our

shoes off for the rest of the visit as we passed by dozens of tombs in order to respect the ancestors.

Finally, we reached the largest tomb yet, where the ritual would be performed. Normally, patients must provide some sort of offering used during the ritual as a sacrifice to the ancestors; we brought soda and candy for the healer to incorporate in the ritual. Then, as the healer began to sing and three other Malagasy people began to play instruments, three other people stood around the tomb, touching it. As the healer continued to sing and scatter the soda and candy on and around the tomb, the three people touching the tomb began to dance, sing, and shriek. They also rubbed white chalk over the face, arms, and chest. This ritual lasted for more than twenty minutes. These people had entered a trance and became possessed by ancestral spirits; it was interesting to note Christian aspects to the rituals, particularly in the form of crosses drawn on the tombs with chalk. Another *tromba* ritual we witnessed that day involved one of the women dancing in the previous ritual. She danced in a small, one-room house as the three musicians played. She held candles and as she entered the trance and danced, she placed the candles inside her mouth. She then told our director that she was possessed by one of her ancestors, who used to be a king of the region, and that he wished to welcome us to Madagascar and that our program would go well.

Most traditional medicine practices are not as elaborate as those we witnessed by the *tromba* healers in Kingory. For instance, healers who practice *mpsikidy* often practice in their own home and only require seeds or stones to determine the cause of the patient's illness and/or predict the patient's future. The seed reader we visited in the rural village

of Andasibe (Figure 2) provided an example for two of the American students. This healer received the knowledge and ability to read seeds and to heal through a religious vision; he claims that he was given direction by God to become a seed thrower. He began seed-throwing when he was 25 years old, and it took him six years to perfect his craft. God instructed him to use a special type of seed from the albizzia plant, and he moves the seeds around in different patterns. To read the seeds of the American students, this traditional healer scattered the seeds across the table and arranged them in parallel lines. After examining them, he revealed things about the students' characters and certain events of their future. Normally, during an appointment with ill patients, he would read their seeds to determine their diagnosis and what types of plants should be used or procedures or behaviors should be done to cure them. At 86 years old, he is now too elderly to gather the plants himself, so his wife has taken on these duties in his place. Later, I found out from several of the Malagasy pharmacology students who interviewed the traditional healers alongside us that they did not believe he was a true traditional healer because of how much he charged; his fee did seem much larger than what the other traditional healers requested. Additionally, when one of the American students asked questions regarding the fate of her brother, the healer asked for 5,000 Ariary (the local currency) in addition. He claimed that the money was what formed his connection with the patient.

Another healer we visited healed with light. He was located in a very poor part of Antananarivo. Like the *mpsikidy*, he saw patients in a small side-room of his own home. Mirrors lined the walls of this small room, with a table along one wall supporting a make-

shift candle stand. This healer emphasized his Arabic and Muslim roots, but there were several crucifixes in the room, as well. The philosophy of this healer is that the illness of a patient consists of darkness, and the presence of light displaces that disease-ridden darkness. When we entered this room, the only light came from one candle, which we used to light five more candles, one for each person in the room. Like several of the other traditional healers we would see, this man displayed his certificate from the Traditional Healer's Association (THA) on his wall.

We interviewed another healer who used a candle and a mirror, but to a different end. This healer, located just outside of Antananarivo, used just one candle and one mirror to view his ancestors, who would inform of him of the diagnosis and treatment that the patient required. This healer does not touch the patient, but receives all of his information from his ancestors. He advises approximately fifty patients per day. Indeed, while we were interviewing him, there were at least twenty-five patients waiting in line outside his door. His room was also lined with tins of various sizes, containing crushed plants and minerals. One of the American students brought up an interesting question while interviewing this healer: does he view other types of traditional medicine as legitimate, or does only his have the power to heal? He responded that it does not matter what type of medicine the healer uses, because all that matters is that the patient is healed. This outlook was repeatedly seen with the other traditional healers we visited.

Another outlook shared by all of the traditional healers is that no recipes or dosages are written down and no patient records are kept. Information about herbal medicine is either passed down through the generations or revealed to the healers through

visions. This practice does not often coincide with allopathic medicine due the apparent imprecision of the methods of traditional healers, and unfortunately, this is often used to discredit traditional medicine. As will be discussed later, different plants must be prepared in the appropriate ways and taken in the proper fashion; just because these medicines are made of plants does not mean they cannot be harmful if taken incorrectly. However, a source of error does exist in that the biochemical properties of plants might change depending on where they are growing and what plants are growing around them. This makes it even more important for Malagasy research companies to study plants used by traditional healers to isolate effective biochemical molecules that might only arise in certain conditions.

Traditional Medicine and Poverty

It is no coincidence that traditional healers are often some of the poorest members of Malagasy society. The individuals whom traditional healers most often serve also live in poverty. Seventy percent of individuals live in rural areas, and 70 percent of those people live in poverty (Juliard, Benjamin, Sassanpour, Ratovonomenjanahry & Ravohitrarivo, 2006). This reality has roots in Madagascar's colonization by the French. Due to racism, Malagasy people with darker skin tones were discriminated against, while those with lighter skin were usually given higher preference or status (Anderson, 2010). As will be explained later, the French founded a Medical school as they began colonizing Madagascar; the students for this medical school came from Antananarivo, and students with higher status (and lighter skin) were chosen. This stratification of social classes pushed Malagasy with darker skin into lower and lower status, and into more and more

poverty. Additionally, just before the 20th century, traditional Malagasy culture was looked down upon by the Malagasy royalty, favoring European customs, religion, and ideals, causing traditional healers and traditional medicine to be outlawed. However, because traditional medicine was such an important part of their daily lives, traditional healers continued to practice in secret, and Malagasy people continued to use traditional methods of cure at the risk of being denounced.

These racial and social issues relate to the access Malagasy people have to traditional and allopathic services in rural and urban areas. In urban areas, such as Antananarivo, there are many allopathic options, ranging from public hospitals to private clinics. However, since the majority of the Malagasy population cannot afford to pursue the allopathic options (even though they are numerous), many choose traditional medicine, instead. In rural areas, however, allopathic facilities are both low in numbers and are distant from each other. Most allopathic facilities are the most basic level and are the first point of contact when seeking biomedical treatment. Malagasy people living in rural areas often have no other choice but to seek the services traditional healers, making traditional medicine the much more realistic, and necessary, choice.

I witnessed this sad reality when my study abroad group and I stayed in Andasibe and later when we travelled to Bekopaka, a rural area in western Madagascar (Figure 2). The closest hospital to Andasibe is located in the town of Moromanga, more than 20 miles to the west (Figure 2). This hospital hosts the only ambulance for approximately 250,000 people. In the deep forests of eastern Madagascar, I could envision how difficult

it would be for the ambulance to reach even some of the homes in the tourist town of Andasibe.

As we were travelling to Bekopaka, the road was extremely bumpy and dusty. The Jeeps we were using did not have seat belts, and I had to hold on to the seat in front of me for the ten-hour drive from Morondava to Bekopaka (Figure 2), or else I would have bumped my head on the window or onto the head of the American student sitting next to me. I could only imagine how much time a sick person would have to wait for someone to receive medical attention from Morondava. Or, what if someone needed ambulatory care and needed an ambulance? On roads like these, keeping someone's head, neck, and back stable seemed impossible, if not useless. To make matters worse, this road becomes flooded in the rainy season, compromising accessibility even further. This gives traditional methods even greater roles in rural areas that are seasonally isolated for part of the year.

Besides being more physically accessible, traditional medicine is often a much more affordable and safer option for the Malagasy people. Plants are used which can be grown in the surrounding forests, avoiding the costs of expensive pharmaceuticals. However, after receiving their diagnosis from the allopathic setting, some Malagasy people buy their pharmaceuticals on a pill-by-pill basis on the "parallel market." This is definitely not how prescription medication should be taken, and could not only prolong the illness of the patient, but could also seriously harm them, as the origins of the medications are not clear. For this reason, traditional medicine is a safer, more reliable option for the Malagasy people. However, there are times when peoples' trust in

traditional medicine is taken advantage of. Some "healers" have historically given traditional medicine a bad name by pretending to have graduated from falsely prestigious universities, and claimed to heal any problem within three to five days. These healers entered this practice merely to make money, and did not stand for what true traditional healers stand for: helping a person heal. All of the traditional healers we visited shared the same philosophy: the issue was not whether or not the patient could pay for the services in full, but only that the patient be healed.

In order to provide regulation and to preserve the integrity of traditional medicine from inexperienced healers, the Traditional Healer's Association (THA) was formed by the Malagasy government. The THA distributes certificates, providing documentation that recognizes the validity of the healer's abilities as a traditional practitioner. However, for healers practicing in rural areas, it can be difficult to acquire these certificates. They may not be able to afford to travel to the training sessions, usually held in the capital city; they may not be able to afford the fees associated with acquiring the license; or they may not be able to read or write to complete the training sessions. In fact, approximately 500 traditional healers are currently registered with the THA, but at least 10,000 traditional healers exist in Madagascar (Juliard et al., 2006).

It is obvious that the majority, rather than the minority, of traditional healers face these obstacles to acquire the THA license, but there is another way to distinguish the true traditional healers from the fake ones: ask the locals. In Andasibe, several of the American students informed their host families of health issues; instead of sending the students to our director, they sent the students straight to one of the traditional healers we

had interviewed just days before. This example illustrates that a healer's lack of a THA license does not equate to their reputability as a traditional practitioner; the regulation and documentation necessary to acquire the license might not be accessible to some healers, but their reputability comes from their genuine service to their community. However, the THA is valuable in that it serves to recognize the legitimacy of traditional knowledge, validating not only traditional healers but Malagasy culture, as well. Although this system is not perfect, and is not the only way recognize the efficacy and overall value of traditional medicine, this government recognition is making traditional medicine legal once more. Originally, when the first medical school was founded, doctors/healers could only practice medicine if they had a certificate from the school, approved by the government. Decree 91-511 of the Code of Health from 1991 states the following: "No one can exercise the profession of doctor, dental-surgeon or midwife if he is not provided with the diploma of a doctor, dental-surgeon or midwife recognized by the Malagasy State and registered on the board of the corresponding national order" (Dr. Randria Narcisse, personal communication, 2011). Basically, since many traditional healers did not have a license allowing them to practice, they were practicing medicine illegally under this decree. However, by forming the THA, the government has given traditional healers the opportunity to become licensed health care workers in order to legally practice again. This is a worthy step in the validation of traditional healers, but the solution to this problem is lacking a way to return validation and legitimacy to all genuine traditional healers – not only those who can afford to obtain a THA license.

III. CHAPTER 2: HISTORY AND COLONIZATION

Madagascar Before European Colonization

Madagascar's early history is one of migrations, with travelers from all over the Indian Ocean having some sort of contact with the island. The earliest points of human contact with Madagascar consisted of small groups of people – from Austronesia, Java, Africa, etc. – arriving in Madagascar and staying on the island either for short periods, or settling permanently on the island over a period of centuries. Razafindrazaka et al. (2010) conducted studies of mitochondrial DNA of three Malagasy ethnic groups and found evidence to support small numbers of migrants existing in isolated groups during Madagascar's early history. According to Randrianja and Ellis (2009), the Malagasy language undoubtedly comes from the Austronesian language group, suggesting that a large wave of migrants came from this part of the world; this suggests interesting migratory and settlement patterns, with Austronesian language and culture becoming dominant on the island, even though continental Africa is much closer.

Early communities in Madagascar were associated with various lifestyles, including trading, agriculture, nomadic hunting, and nomadic fishing. The estuary areas of the northwest, northeast, and southeast regions were the more desirable places of settlement on the island due to the accessibility and success of trade lifestyles. Europeans, along with Indian Ocean populations, traded cloth, spices, rice, other foods, and slaves (Hooper, 2011). These areas became more densely populated than the south and the highlands, which were the last areas to experience prolonged human contact from migrating communities, with permanent settlements in the 12th and 13th centuries

(Randrianja & Ellis, 2009). However, evidence from pollen and other archeological studies suggests that the highlands were home to nomadic herders and hunters as early as the eighth century (Randrianja & Ellis, 2009). Although not much is definitively known about the early history of Madagascar, anthropological evidence suggests that the small settlements in the beginning of Madagascar's history were self-governing; authority and power rested with individuals, and heads of lineages were thought to have religious powers associated with agriculture and the sky (Randrianja & Ellis, 2009). Throughout Madagascar's history, customs such as language and religion of the various migratory groups gradually became incorporated into the growing Malagasy culture.

Even in its early history, ecological devastation by humans was no rare occurrence on the island of Madagascar. Slash and burn agricultural techniques, called *tavy*, were adopted by early settlers to clear areas for farming and shelter (Randrianja & Ellis, 2009). By the early 13th century, several species of animals endemic to Madagascar became extinct, including the dwarf hippopotamus, the giant, flightless, aepyornis bird, and several species of lemur. Cattle were introduced to Madagascar from Africa early on; they became a symbol of wealth and were used in religious rituals such as sacrifices and were exchanged as a kind of dowry in Malagasy marriages. Eventually, they became wild on the island, and families and communities traded them amongst each other.

Islam had a heavy influence on the growing Malagasy culture, beginning around 1000 CE. This influence grew as early Malagasy peoples traded with Arabic and East African communities (Hooper, 2011). Muslims began to build mosques on the northern ports of Madagascar, and brought new knowledge to the island. Holy men known as

ombiasy (as well as *mpsikidy*) existed before the immigration of Islam, but aspects of the Islamic religion became incorporated into these professions. Other aspects of Islam became a part of the overall Malagasy culture, including the belief that the northeast corner of the house is a sacred place; here, ancestors were honored and important objects were kept (Randrianja & Ellis, 2009).

The writings of European visitors, such as the Portuguese Jesuit Luis Mariano, provide more information about the Islamized immigrants than earlier settlers. Luis Mariano stayed in Madagascar from 1613-1614 and from 1616-1617 and 1619. His writings help outline the arrivals of Islamized groups on Madagascar's east coast, and also reported information about Malagasy society and politics on the west coast of Madagascar. In his writings, he commented on languages used in northwest Madagascar, saying that people coming from the southern part of Africa spoke Swahili, but the Madagascar natives spoke a language more similar to Malay (Verin & Wright, 1999). He used the word *buques* to refer to Malagasy-speakers, *mauros* to refer to Swahili-speakers, and *cafres* to refer to speakers of other African languages (Ellis, 2007).

The slave trade was an important part of trade in nations around the Indian Ocean, and Madagascar was no exception. As early as 1228 CE, Malagasy slaves were being sent to Persia, Yemen, and Arabia, suggesting that the population had grown to such an extent to provide exports of slaves without diminishing the already-established communities (Randrianja & Ellis, 2009). European powers attempted to make slave trade a successful commercial exchange, but these attempts were abandoned when the British

saw the slave trade as a distraction from trading for other items, such as food (Hooper, 2011).

The Portuguese were the first Europeans to regularly travel and trade the Indian Ocean since ancient times. When Portuguese traders, along with Dutch, English, and French traders, began trading and making contact with the ports of Madagascar, they found that long-distance trade routes were already well established by populations of the western Indian Ocean (Hooper, 2011). The *Antaloatra*, a Malagasy word for foreigners, were people of the Comoros Islands, India, or of Arab descent and formed communities in northern Madagascar, selling rice and slaves with the Africans and Arabs who visited their ports around the 17th century. This group of people followed Islam and shared some cultural practices with people of the coast of East Africa; Swahili and Arabic were spoken by some members of this group, pointing to the strong trade relationship between the natives and East Africa (Hooper, 2011).

Because of the trade routes already in place by the *Antaloatra*, and people of other ports, the Portuguese were unable to maintain unified control of trade in this area (Figure 3). The Portuguese blamed the overwhelming presence of Islam and anti-Christian sentiments for this failure. No longer a dominant presence in the commerce and trade in this part of the Indian Ocean, the Portuguese resorted to trading for food and slaves between Mozambique and the northern region of Madagascar (Hooper, 2011).

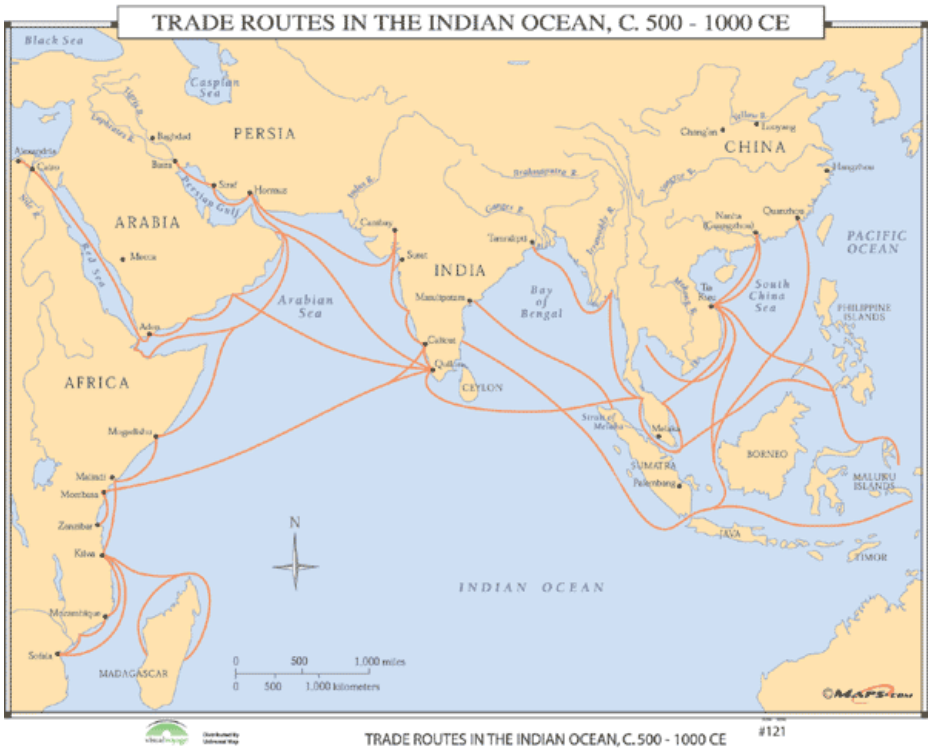

Figure 3. Trade routes in the Indian Ocean, C. 500-1000 C.E. Source: http://www.worldmapsonline.com/UnivHist/30299_6.gif

The previous establishment of trade routes by peoples of the Indian Ocean and the fragmented, disorganized peoples of Madagascar made it difficult for subsequent European powers to gain a firm hold on the commerce and trade routes on the island, let alone in the area of the greater Indian Ocean. Sea lanes were not directly controlled by any European power. For trade companies like the English East India Company, it was difficult to monopolize the Indian Ocean trading system because of its vastness, with people from Madagascar trading with communities as far away as India and Polynesia (Hooper, 2011).

Around 1700, the *Sakalava* people of western Madagascar had a firm control on trade in that region, but no prominent trade groups existed in the east. However, the presence of European pirates (ex-privateers) after 1650 also made it difficult for European powers to establish a firm position among the Malagasy people. Pirates made agreements with Malagasy elites, often trading firearms for food and slaves. Pirate communities particularly found refuge in the eastern part of Madagascar (Hooper, 2011). The English government sent ships to capture pirates and eliminate their disturbances on trade routes, and by 1737, the English and French became more and more concerned with piracy along the coast of India. However, the English and French were still the prominent European powers and could finally share in the stability of Malagasy trade routes, thanks to the elimination of violent piracy and unified Malagasy groups.

After the elimination of most pirate activity, several Malagasy groups incorporated their former associations with pirates into their history and identity, apparently making it easier for them to attain political control. This shared identity catalyzed the formation of the *Betsimisaraka* people ("the many who are not separated") in eastern Madagascar. Their claims to pirate ancestry gave them legitimacy as a trade presence because of their access and connections to other parts of the Indian Ocean (Hooper, 2011). Pirates sought refuge in the *Sakalava* people, whose king gave special treatment and allowances to foreigners in his territory. They even used their close relationship with pirates as leverage in trade negotiations and gained military and linguistic knowledge from them.

After each became more unified due to trade practices and pirate ancestry, the relationship between the *Betsimisaraka* of the east and the *Sakalava* of the west involved both peaceful trading and military attacks, often using French weapons. Using power gained from trade relationships within and around Madagascar, these two groups represented unified Malagasy populations by the end of the 18th century (Hooper, 2011). However, both the increasing presence of the Merina kingdom from the Highlands and the greater-than-ever pressures of the British and French forces on the coasts, who began to establish their commercial and political presence in the Indian Ocean, limited the expansion and threatened the trade systems of the *Bestimisaraka* and the *Sakalava* peoples.

By 1814, the British had established military and commercial bases on the shores of the greater Indian Ocean, giving them a better chance of direct access to Madagascar. Although attacks from the *Betsimisaraka* and the *Sakalava* threatened the establishment of the British presence on the island, the British eventually gained control of the island and took advantage of the now-stable trade routes within Madagascar, as well as the increasing unity of the various Malagasy groups. The British began to influence the politics and economics of Madagascar greatly when they began to colonize and joined forces with Radama I, the Merina king, not long after 1814.

Madagascar at the Time of Colonization

King Andrianampoinimerina ruled the Merina kingdom between 1787 and 1810 and is noted for his efforts to unify the rest of Madagascar's kingdoms under his rule

(Randrianja & Ellis, 2009). The acquiring of European firearms helped Andrianampoinimerina in his conquests. His successes allowed his son, King Radama I, to further unite Madagascar under one rule with the help of a centralized, dominant military; he reigned from 1810-1828. Radama I ruled at a time of great western influence and helped spread European customs and religions, including Christianity (Campbell, 2005). At this time, Britain had a heavy interest in Madagascar, and in 1817, Radama I formed a treaty with Britain. The British spread their customs throughout the island through organizations such as the London Missionary Society (LMS), a protestant missionary group that built schools, churches, and hospitals around Madagascar during the reign of Radama I. However, the real motivation behind these efforts was to prepare the country for European colonization. With the aid of the European forces, Radama I expanded his territory further and further across Madagascar. In addition to having missionary and trade relationships with the British, Radama I formed trade pacts with the French, who experienced a weakened international presence due to their losses of Mauritius and the Reunion Island (Randrianja & Ellis, 2009).

Queen Ranavalona I succeeded Radama I, her husband, after his death and became queen of Madagascar from 1828 to 1861. Her reign was much different from that of her husband. She tried to close Madagascar off to foreign powers (even restricting the LMS) and also closed trade treaties with the Europeans (Campbell, 2005). This queen forbade the practice of Christianity and enforced traditional Malagasy beliefs, *fady* (taboos), and the traditional value of ancestors. She built an army of Merina soldiers who served to control the outlying regions of Madagascar, and further expanded the territory

under her rule. Queen Ranavalona I was very violent and was viewed by many as a tyrant, having killed nearly anyone who disobeyed her laws. Malagasy people would accuse each other of disobeying the Queen and would turn each other in to undergo the *tangena* ordeal (Campbell, 2005). This traditional Malagasy ritual involves the suspected person consuming a poisonous plant; if the individual survived, they were innocent, but if they were poisoned by the plant and died, they were deemed guilty. Over 100,000 individuals of the Merina kingdom – approximately 20 percent of the population – died in this way.

The purpose of the tyrannical rule of Ranavalona I was to secure Malagasy customs and culture through the repression of Christianity, which she believed would cause the Malagasy people to abandon their own ancestors and culture (Campbell, 2005). She was cautious of foreign influences, especially the French, who had control over many of the small islands surrounding Madagascar, and the British, who wished to secure a passage to India. The British forces in Madagascar, including the LMS, were forced to leave. Any individual suspected of practicing Christianity or customs of the European powers interested in securing Madagascar were placed under the *tangena* ordeal; Queen Ranavalona I hoped this practice would help to encourage her subjects to respect Malagasy history and culture.

Queen Ranavalona I was succeeded by her son, Radama II. By this time, almost the entire island of Madagascar fell under his rule, which lasted from 1861 to 1863. With the reign of Radama II, Madagascar's borders were opened again to foreign powers (Randrianja & Ellis, 2009). Radama II's reign is noted for its opposition to the reign of

his mother. Christians were no longer persecuted, missionaries were allowed back into the country, and trade routes with Britain and France were reestablished. During the reign of his mother, Radama II even formed the Lambert Charter with the French, allowing the French access to Madagascar's land and resources. This was instrumental in securing France's hold on Madagascar, eventually allowing them to make it a French Colony in 1896. To the Malagasy people, land was viewed as property of the ancestors; therefore, the Lambert Charter allowing foreigners to permanently own land was troubling to Radama II's subjects. Unhappy with the abrupt reversal of rule which threatened the traditional sociopolitical atmosphere, the prime minister of Madagascar and the Imerina nobles were skeptical of Radama II's intentions and carried out his assassination in 1863 (Campell, 2005).

Queen Rasoherina succeeded Radama II, her second husband, after his assassination; however, Prime Minister Rainivoninahitriniony held the most influence over Madagascar at that time. This prime minister actually brought about the assassination plot against Radama II and married the queen soon after she was crowned. However, a new prime minister soon took his place because of his incompetence as a ruler. Ties with Europeans continued to be established, with Malagasy ambassadors being sent to Britain and France; however, the Lambert Charter was abolished, and a treaty was signed with the United Kingdom to give Madagascar land rights to the British (Randrianja & Ellis, 2009; Campbell, 2005). Indeed, during this stage in Madagascar's history, ties with the British were strengthened greatly.

Queen Ranavalona II succeeded her cousin Queen Rasoherina upon her death. During Ranavalona II's reign from 1868 to 1883, the island experienced a great push towards Christianity, as the Queen was tutored by Protestant missionaries (Campbell, 2005). Interestingly, deforestation was addressed during her reign, ordering the construction of buildings to be done with brick and banning the traditional practice of *tavy*, or slash-and-burn agriculture (Gade, 1996). This agricultural practice has been largely responsible for the destruction of approximately 75 percent of the natural forest in Madagascar, and this practice is still used today. However, most notably, on March 29, 1881, Queen Ranavalona II created the Code of 305 articles. These were meant to create a European, Christian standard of Madagascar and to remove all traditional and ancestral Malagasy customs (Campbell, 2005). This included any traditional medicine customs, and the decree mentioned earlier stems from this code. Her reign encouraged the implementation of European, allopathic medicine into Malagasy society.

As the last ruler of Madagascar, Queen Ranavalona III succeeded Ranavalona II. Ranavalona III reigned from 1883-1897 and entered a political marriage with the Prime Minister of Madagascar, Rainilaiarivony, as the former queens had done before her. The final queen of Madagascar and her husband could not fight off increasing political and military attacks by the French, until finally French annexed Madagascar as a colony in 1896. Resident Governor Galliéni exiled Ranavalona II from Madagascar in 1897, and she fled from Madagascar, to Reunion Island, and finally to Algeria, where she died in 1917 (Randrianja & Ellis, 2009).

After having troops from Madagascar fight for France in World War I, and the potential establishment of Madagascar as a site for the deportation of Jews, Madagascar became independent of France in 1960 (Randrianja & Ellis, 2009). The road to independence was largely inspired by the Malagasy Uprising of 1947, in which Malagasy nationalists revolted against French authorities. However, independence was achieved on comparably peaceful terms, and the new Malagasy republic reflected administrative and political aspects of former colonists.

IV. CHAPTER 3: THE INTRODUCTION OF ALLOPATHIC MEDICINE AND MADAGASCAR'S CURRENT HEALTH CARE SYSTEM

The Introduction of Allopathic Medicine

From the time of colonization to the present, the state of traditional medicine in Madagascar has endured a roller coaster of legality and illegality, acceptance and rejection. Most notably, in 1881, Queen Ranavalona II implemented the Code of 305 articles in attempt to westernize Madagascar. These articles banned many aspects of ancestral Malagasy society, from worshiping *sampy* (idols) to using traditional medicine. Any customs that defied Christianity were looked down upon by the queen. This attitude towards Malagasy cultures more amply facilitated the introduction of European, allopathic medicine into Madagascar (Dr. Randia Narcisse, personal communication, 2011). Gillian Scott, who has studied ethnobotany and the state of traditional medicine in South Africa, states the following: "Traditional practitioners, although highly respected in their communities, played almost no role in the establishment of formal healthcare systems in Africa" (2010). This is definitely the case in Madagascar, where these formal health care systems were established by European powers in the form of missionary organizations and groups seeking to colonize the country. Indeed, the Malagasy began to learn medical knowledge in this way around 1838, but during the reign of Queen Ranavalona I, foreign powers were obliged to leave the island, including the medical missionary groups. However, once the reign of Queen Ranavalona I ended in 1862 and her son, Radama II, became king, foreign powers were welcomed back to the island and

missionary groups were once again able to spread medical knowledge. At this time, medical teaching really began to take root in Madagascar.

Even before the French colonized Madagascar, allopathic medicine appeared on the island through missionary groups such as the Medical Missionary Academy, a protestant mission from England. This group created a school of medicine in the late 19th century, from which 40 native doctors graduated ("Medical Assistance for Indigenous Peoples," 2011). Begun by Dr. Christian Borchgrevink, the Medical Mission Academy remained in place until 1896, with the arrival of the French ("USC Digital Libraries," 2011). Dr. Carl Johan Guldberg, who helped to found the Medical Mission Academy in 1886, also worked with the Lutheran-affiliated Norwegian Missionary Society (NMS). Previously, in 1880, Guldberg worked with other missionaries to create classes for students from the Kolejy Medikaly Malagasy, or Malagasy Medical College (Munthe & Molet, 1977). Therefore, before the dominance of French colonialism, allopathic medicine had already begun to make an appearance in Malagasy society.

When the French colonized Madagascar, they implemented an organization called the Association of Medicine for the Indigenous (AMI) with the intention of providing free health care to the Malagasy people. This program, initiated between 1896 and 1901, served as a model to other French colonies in Africa. General Galliéni was the first resident governor of Madagascar and initiated the AMI under the veil of humanitarianism (Anderson, 2010). The goal of the AMI was to instruct Malagasy people to become medical staff, so that they would not have to rely on too many doctors coming from Europe to work in Madagascar. This health care policy was exclusively funded by the

state, encouraging the Malagasy to take care of their health so that they could work for the French colonists (Professor Andry Rasamindrakotroka, former Minister of Health, personal communication, 2011). On December 11, 1896, a school of medicine was founded by the French in Antananarivo in the name of the AMI, specifically for Malagasy students from the highlands. Training native doctors would lessen the expenses of the French, who would no longer have to transport French doctors to Madagascar. However, the school of medicine soon became a medium to ensure the presence and influence of the French; the curriculum was based on teachings from French universities (Dr. Randia Narcisse, personal communication, 2011). Locating the medical school in Antananarivo was strategic for the French, because they associated the transfer of medical knowledge as a transfer of power. The French thought it would be most appropriate to associate this power with the traditional elites of Malagasy society, the *Hova* (freemen) of the *Merina* people of the highlands. (Dr. Randria Narcisse, personal communication, 2011). At first, the transfer of medical knowledge was inhibited due to the language barrier and the clash of European medical customs with traditional Malagasy medical knowledge. However, these obstacles were soon overcome, and by the year 1899, the school hosted 73 medical students from the Highlands. The AMI medical system was organized administratively, with the central level located in the highlands; but this centralization was due to both limited numbers of staff and the efforts to unify the entire island under the direction of the French and pacify domestic warfare (Dr. Randria Narcisse, personal communication, 2011).

Because of medical missionary groups, the AMI, and the Antananarivo medical school, European medicine began to be rooted in Malagasy society. Not only did the AMI offer an example for the organization of medical systems in other colonies, but when Malagasy became independent from France in 1960, the new country developed its health care system based off of the former colonists.

The Current Structure of the Health Care System

After Madagascar became independent from France in 1960, the national health system reflected the French administrative system in that it was highly centralized. However, this changed in 1992 when the Constitution was altered in order to initiate the decentralization of the national health system, relocating limited decision-making responsibilities through to lower levels of the system instead of the center (Sharp & Kruse, 2011). The Malagasy government also replaced the six provinces included in the health system with twenty-two regions. In all, the government enacted these changes in hopes that public resource management and the public service delivery system would be improved and would become even more consistent across the regions (Sharp & Kruse, 2011). Although the desired consistency has not yet been achieved, the ability of regions to be responsible for allocation of medical supplies and even a part of the investment budget has shown promising results in several regions. This "deconcentration" of duties throughout the central, regional and district levels involves distinct roles and responsibilities on the part of each level; these levels also reflect the administrative structure of Madagascar's government. The central department of health is more strategy-oriented, coordinating policies and activities of the entire sector. Meanwhile, the regional

level is in charge of implementing Madagascar's national health policy in each respective region, and the district level serves on the basis of district hospitals and health care centers (Sharp & Kruse, 2011).

Madagascar's health care delivery network includes the public sector, private sector, and traditional healers. The public sector includes hospitals, primary care clinics, public health institutes, laboratories, and hygiene offices, while the private sector includes hospitals, referral centers, laboratories, and NGOs. Most of the private health centers are located in urban areas. The allopathic health care system in Madagascar is split up into commune, district, regional, and central levels. At the commune level, there are *Communautés Santé de Base*, or CSBs. These are considered primary health care services. Vaccines are available here, free of charge. Level I CSBs (CSB I) are staffed with a paramedic, and level 2 CSBs (CSB II) are staffed with a doctor and a paramedic. In 2007, there were approximately 1,139 CSB I facilities and 2,064 CSB II facilities in Madagascar. Most of the CSBs are level I, but more level I CSBs are being transformed into level II, in accordance with a Ministry of Health strategy to improve the state of Madagascar's health care system (Dr. Herlyne Ramihantaniarivo, MD, MPH, en Service à la Direction Générale de la Ministère de Santé, 2011). Approximately three-quarters of both CSB I and CSB II fall under the public sector, although some are private with a religious basis, or private and non-religious. Each CSB facility serves approximately 2,000 to 14,000 inhabitants; indeed, the distribution of CSB facilities across Madagascar, especially in rural areas, seems neither equal nor adequate (Sharp & Kruse, 2011).

The district level consists of *Centres Hospitaliers de Districts* (CHD) which off services provided at CSBs in addition to emergency surgery services, gynecological-obstetrical care, and referral services. If the services needed by the patient are not supplied at the CSBs (both levels), the patient is sent to a CHD. In 2007, Madagascar had 70 CHD I facilities and 52 CHD II facilities (Dr. Herlyne Ramihantaniarivo, personal communication, 2011). Again, the CHDs can be divided into private and public, the majority being public. Of the public CHDs, CHD I provide services to medical cases and CHD II provide emergency surgery and gynecological-obstetrical services, in addition to referrals ("Healthcare in Madagascar," 2007; Sharp & Kruse, 2011). As with CSBs, the Ministry of Health is striving to develop more CHD I facilities into CHD II. The bed capacity values among some of the provinces are: Antananarivo, 1046 beds; Toamasina, 633 beds; and Toliary, 595 beds ("Healthcare in Madagascar," 2007). However, there are only about three beds per 10,000 people in Madagascar. This makes Madagascar one of the lowest-ranking countries in Africa in terms of hospital bed density; only Guinea and Ethiopia have lower values than Madagascar (Sharp & Kruse, 2011). Meanwhile, the bed density in France, a country only slightly larger than Madagascar, is 72 per 10,000 people.

Following the commune and district levels is the regional level, which consists of *Centres Hospitaliers de Reference Régionale* (CHRR), or referral centers. These centers provide the services offered at CHD, along with major surgery and secondary referral services. Twenty of these regional hospitals exist in Madagascar (Dr. Herlyne Ramihantaniarivo, personal communication, 2011; Sharp & Kruse, 2011).

Finally, the central or national level includes *Centre Hospitaliers Universitaire* (CHUs), or university training hospitals. These facilities are also referred to as les *Centres de Reference Nationale*. These facilities offer the same services as the CHRRs, in addition to specialized surgery, oncology, and some research capabilities. The bed capacity of CHU/CHRR facilities in each province is: Antananarivo, 1502 beds; Antsiranana, 300 beds; Fianarantsoa, 309 beds; Mahajanga, 195 beds; Toamasina, 335 beds; and Toliary, 242 beds ("Healthcare in Madagascar," 2007). Only two CHU facilities exist in Madagascar, with one located in Antananarivo and the other located in Mahajanga, located in northwest Madagascar (Figure 2). Neither CHU nor CHRR facilities have private counterparts; the totality of these facilities falls under the public sector.

But how accessible are these services, and how affordable are they? The ministry claims that all medical services in Madagascar are free; so why is it that so many cannot afford health care? Why were 50 percent of Malagasy children anemic in 2008-2009 (Professor Andry Rasamindrakotroka, personal communication, 2011)? If medical services in Madagascar were really free, one would expect these numbers to be much lower. Where do the discrepancies lie? The reasons behind such high statistics may be attributed to sources outside of the health sector, including education and lack of proper nutrition and food supplies.

Furthermore, the consultation that a patient undergoes with a health care professional is technically free of charge; but if the patient requires tests, further examination, or medication, they are required to pay (Dr. Herlyne Ramihantaniarivo,

personal communication, 2011). If they are unable to pay, they are turned away and are not provided with the appropriate services. It is here that we see the financial strain that the health care system can place on patients.

Limitations of the Current System

A number of limitations negatively affect the health care system, its infrastructure and its delivery. Although this is by no means an exhaustive list of the limitations currently experienced by the system, I have chosen to include issues I experienced either first hand by visiting hospitals and CSB facilities in Madagascar (both public and private), or issues I encountered during my studies there.

First of all, there is a severe lack of health care workers with less than 2.3 doctors, midwives, and nurses per 10,000 people (Sharp & Kruse, 2011). There is especially a disproportionately severe shortage of nurses and midwives at 3.16 per 10,000, as opposed to 2.91 doctors per 10,000. Interestingly, this makes the nurse density one of the lowest in Africa and the doctor density one of the highest. In fact, there is a severe shortage of nurses at the CHD I and CSB II levels in particular (Sharp & Kruse, 2011). Sharp and Kruse (2011) also report that approximately 28 percent of doctors serve 75 percent of the population in rural areas, while the other 72 percent of doctors serve in urban areas. Meanwhile, 60 percent of paramedical staff serve in rural areas (Dr. Randria Narcisse, personal communication, 2011). Thus, not only is there a severe shortage of health care personnel, there is also inadequate distribution of the personnel with specialized training throughout the country.

Another limitation to the efficacy of Madagascar's allopathic health care system is the outdated quality of most of the medical equipment. This is largely due to the fact that no domestic production of medical supplies occurs in Madagascar (Dr. Randria Narcisse, personal communication, 2011). Along with high import taxes required for medical materials to enter the country, the purchase of new equipment is a great expense. Because the current medical equipment is so outdated while new equipment is so expensive to obtain, there is a general lack of medical supplies that contributes to the inadequacy of the health system's infrastructure as a whole. The shortage of the material is also due to inadequate budget allocations and, at times, theft. The poor state of medical equipment also leads to insufficient function, especially surgical function.

Additionally, there is an inconsistency with how often health care personnel remain at their posts. Sharp and Kruse (2011) discuss the results of a survey which involved visiting health care facilities at randomly-chosen times throughout the year to assess absenteeism of health care workers. The most commonly-cited reasons for being absent from the health care centers were the following: to complete official missions, such as attending official meetings, conducting field visits, and attending training; to acquire their salaries from district-level facilities, which may involve traveling to another city; or to recover from being ill. Approximately 20 percent of health care workers included in this study were absent for unauthorized reasons. This has detrimental ramifications for patients, considering the shortage of health care workers that Madagascar is currently experiencing. Even worse, the infrastructure does not account for properly replacing health care workers when they are absent; 54 percent of absent

personnel do not have their positions filled during their absence, which compromises the quality of service delivery and the patients' access to health care even further (Sharp & Kruse, 2011). Additionally, there is an issue with doctors not doing what they were trained to do, in combination with the fact that such a low number of health care training institutions exist; for instance, one medical school is located in Antananarivo, and the other is located in Mahajanga (Dr. Randria Narcisse, personal communication, 2011). Therefore, the issue might not only be the lack of health care professionals, but that these professionals exist and are not putting their training to proper use. For instance, doctors may become taxi drivers, take up other posts in society, or are merely absent from their post due to unauthorized reasons; this problem may be due to lack of incentives to remain in the health care industry (Sharp & Kruse, 2011; Dr. Randria Narcisse, personal communication, 2012). Additionally, public doctors may practice privately at home, allowing them to charge their patients more so that they can make more money (Dr. Herlyne Ramihantaniarivo, personal communication, 2011). The unreliable presence of health care workers makes patients' access to health care even more limited and expensive.

According to surveys conducted throughout Madagascar, Sharp & Kruse (2011) report that physical access and financial instability are the main reasons behind the inadequate access to health care. Sixty-five percent of the rural population lives more than five kilometers away from the nearest CSB facility (Dr. Herylne Ramihantaniarivo, personal communication, 2011). These barriers to acquiring proper medical attention lead individuals to either judge their illnesses as not serious enough to go to the clinic or to

improperly self-medicate. Suffering with their afflictions outweighs the difficulty of traveling long distances to health care facilities and/or the financial burden of seeking proper treatment. Barriers to physical access not only include long distances, but also include inaccessibility of seasonally isolated health centers during the rainy season. During this time, it is impossible to refer patients to other hospitals; also, the arrival of new drugs and medical supplies is much slower.

Sharp and Kruse (2011) also report that the infrastructure of the public sector is further diminished by lack of access to running water, electricity, and a medium of transportation, and the state of the ceilings, walls, floors, and that the medical equipment of public facilities is in a notably poorer state than those of private facilities. Only 83 percent of public health care centers have access to running water, while private health care centers rarely have issues with this. Fifty-four percent of public facilities have access to electricity, and 51 percent have some type of functional transportation. For the most part, private facilities have access to electricity, but only 44 percent have access to a mode of transportation. These figures are dramatically lower for facilities in rural areas. I am reminded of the CHD facility in Moramanga, which only has one ambulance to serve an area with over 250,000 people. However, having a functional medium of transportation does not necessarily mean it is accessible to all people. In the rural village of Andasibe, access to the homes throughout the village was limited to narrow, winding dirt paths, making it difficult for a possible rescue mission involving an ambulance.

The lack of medical resources, especially the drug supply, has been worsening over the past ten years in Madagascar. Not only has the number of prescriptions written

been declining, but there is a larger and larger discrepancy between the number of prescriptions written and the number of prescriptions actually being filled (Sharp & Kruse, 2011). The poor state of this aspect of the health care infrastructure has relevant connections to traditional medicine insofar as meeting demands of the failing drug supply and inspiring possible solutions to the problem, and thus merits its own section.

The Drug Supply and the Purchasing of Pharmaceuticals

As with health care facilities, the drug supply for the Madagascar health care system is partitioned into different levels. The Ministry of Health put program called SALAMA into practice in attempt to increase accessibility and availability of drugs at more affordable prices, making SALAMA the "semi-autonomous central drug procurement agency for the Government of Madagascar" (Sharp & Kruse, 2011). Through a system based off purchase orders, SALAMA supplies drugs to District Pharmacies, which then supply the health centers (Dr. Herlyne Ramihantaniarivo, personal communication, 2011). The drug supply of the health center is locally supervised by a Community Management Committee, made up of village members of the area served by the local pharmacy and health care center. To put it simply, money gained from the sale of drugs is received on the local level and deposited into an account managed by the committee, whose funds are used to purchase pharmaceuticals, pay for transport and general upkeep of the health center and are monitored by the president and treasurer of the committee (Sharp & Kruse, 2011). The committee turns the cash payment into check form in order to procure drugs from the district pharmacy, and the community pharmacy or CSB acquires the drugs after the checks and purchase are processed.

As mentioned earlier, the availability of drugs has been in a decline for the past ten years. That is to say, although drug shortage is an issue at times, the drugs are available to patients but cannot be purchased due to financial burdens or physical barriers. Sharp and Kruse (2011) conclude that it is becoming more and more difficult for patients to find prescribed drugs at the public pharmacy based on these costs. Indeed, actual drug shortages are prevalent during the rainy seasons, when replenishment of drug supplies is not only difficult, but impossible at times. The high cost of drugs may account for the discrepancy between the amount of prescriptions written and the percentage of those prescriptions that are actually filled. There are also user fees involved in filling prescriptions that add to the expense of acquiring pharmaceuticals.

Sharp and Kruse (2011) also cite a Service Delivery Study which revealed that there is a month-long waiting period between the time the districts place orders with SALAMA and the time the district pharmacy receives the drugs. After this point, the drugs still have to make it to the community pharmacy and/or CSB facility. The study also revealed that this month-long process has four steps. First of all, the district pharmacy must obtain permission to fulfill the order from the District Health Authority; this step can take up to four days to be completed. In the second step, which takes about 12 days, the purchase order is mailed to SALAMA so that an invoice for the order can be issued. Thirdly, the invoice is paid by check through the work of the committee, which adds an additional four days. Finally, the fourth step involves shipment of the actual drugs to the district pharmacy; once the payment is received, the drugs arrive at the district pharmacy about 12 days later (Sharp & Kruse, 2011). The lengthy wait involved

in the patients' procurement of drugs might further discourage them from filling prescriptions. Why spend a large amount of money on drugs that take so long to arrive that the symptoms have disappeared, or maybe even gotten worse, only to require another visit to the pharmacy for a new drug regimen by the time the first prescription finally arrived?

Yet another issue with the current system of drug supply is that of leakage. Sharp and Kruse (2011) explain that, unfortunately, both value/price leakage and quantity leakage occur in Madagascar's drug supply system. Value/price leakage occurs when the district pharmacy claims to have sent goods of higher value than the health center pharmacy reports to have received. This type of leakage also occurs when the health center pharmacy claims to have paid a higher price than the district pharmacy had paid. Quantity leakage occurs when the health center pharmacy receives fewer drugs than the district pharmacy reported to have sent. Approximately three out of four local health center pharmacies report the occurrence of leakages at some point in the supply chain from the district level to the commune level (Sharp & Kruse, 2011). The isolation of health centers, weakness in the system infrastructure, and the poor management and regulation of accounts contributes to the high prevalence of leakages. These discrepancies may also be due to a certain level of corruption and lack of supervision throughout the system.

Although this method of supplying drugs was created to alleviate the inability to pay, many still cannot afford the expenses of pharmaceuticals. Also, this method may not always be accessible to the Malagasy people, especially those in seasonally isolated, rural

areas. However, even in urban areas, drugs may be available but inaccessible for the poor and extremely sick due to high costs. To put it simply, patients who cannot afford to pay for prescribed pharmaceuticals are turned away, and either purchase their medication outside the pharmacy on the "parallel market," or turn to a traditional healer (Dr. Herlyne Ramihantaniarivo, personal communication, 2011). The use of medicinal plants, which are easily accessible and are often five-to-ten-fold cheaper than pharmaceutical drugs, can solve many (if not all) of the issues present in the current drug supply system if the players carry out their duties responsibly and sustainably.

The Condition of Health Funding and Health Insurance

In the current system, consultation and care are proclaimed to be free of charge. However, this statement is misleading, because the patient must pay for medicine and treatment once the diagnosis is made during the consultation. In order to pay for these expenses, different levels of health insurance do exist, although they seems to be more widely used in urban areas such as Antanarivo, where more people are able to afford these services. However, the percentage of people who can afford health care in the first place is extremely small, arguably from one percent five percent of people. During an interview, when a doctor at the CSB in Andasibe was asked whether any of the people in the village had health insurance, his answer was a distinct "no". No one in Andasibe, a rural community, has the means to pay for health insurance. However, different levels of payment are available to those who are willing and able to pay. In any case, purchasing health insurance is virtually useless if the accessibility of care is not realistic.

Because such a large proportion of the Malagasy people are poor, other mechanisms of health funding have been proposed in attempt to address this issue. For instance, the Equity Fund and FANOME (*Fonds d'Approvisionnement Non-stop des Médicaments*) were created in light of the fact that many of the poor people of Madagascar pay out-of-pocket for medical expenses, and financial barriers such as these prevent people from seeking further medical care. These funds take away the expenses involved in procuring drugs, paying for tests (such as X-rays, ultrasounds, ECGs, EKGs, etc.), and providing financial help in various ways, including compensating for user fees and covering costs of drugs for the poorest members of the community. The community health committee and the local administrative authority of the village are responsible for providing lists of people who qualify for payment through these schemes. However, the population included in these lists does not always properly reflect the actual poverty scheme of the community (Sharp & Kruse, 2011; Dr. Herlyne Ramihantaniarivo, personal communication, 2011). Some people may not want to consider themselves to be poor out of pride (in association with social stigmas), and corrupt mayors and employers may create inaccurate lists so that they do not have to pay as much money. Additionally, it has been reported that this program is not well understood by the population that the program aims to help (Dr. Herlyne Ramihantaniarivo, personal communication, 2011). If two out of three people in Madagascar are reported to be living in poverty, these funds do not seem to be sufficient enough to properly address the health care needs of the population.

Sharpe and Kruse (2011) report that "the objectives of health insurance schemes are to pool risks, foster prepayment, raise revenues and purchase services." However, health insurance schemes are very limited in Madagascar and are not a significant source of health care spending; there are simply not enough people with enough financial stability to pay for such schemes (Dr. Randria Narcisse, personal communication, 2011). Sharp and Kruse (2011) further state that "a small number of health insurance schemes do exist, but only cover a small fraction of the population that typically does not include the poorest and/or sickest." Albeit limited, four types of health insurance exist in Madagascar, including state-based systems which are funded by the government, social health insurance, private health insurance, and community-based health insurance (Sharp & Kruse, 2011).

First of all, state-based insurance systems are the most common mechanisms in use in Madagascar, especially since the Ministry of Health serves as the main provider of health services; however, the system is neither equitable nor efficient (Sharp & Kruse, 2011). These types of systems are funded by general revenues, are created with the purpose of providing insurance for the entire population, and are distributed through a series of public providers (in this case, the Ministry of Health primarily). This type of health coverage has the potential to be very effective, but unequal access to care, improper budget distribution, and unreliable funding all contribute to the downfall of the system.

As for social health insurance, which involves payroll contributions from both individuals and employers and independent insurance funds, individuals can expect a

defined package of health benefits (Dr. Herlyne Ramihantaniarivo, personal communication, 2011; Sharp & Kruse, 2011). In this case, health insurance is easier to oversee for patients with formal, stable employment. However, in Madagascar, 95 percent of working adults are informally employed, making this health insurance scheme an improbable solution at the present time (Sharp & Kruse, 2011).

Mutual insurance exists, falling under the private health insurance scheme, but this type of insurance is exclusively accessible only to individuals who are formally employed, most often found in urban areas. Mutual insurance is very expensive and many cannot afford it or even qualify for coverage. Private health insurance schemes are complex and cannot be properly supported by the current state of the health care system's fragmented, unstable infrastructure.

On the other hand, certain community-based health insurance schemes that have been put into practice in the last ten years have shown promising results. In these types of schemes, patients make payments on their own terms to help cover medical expenses throughout the year. These pilot projects were instated with the financial barriers of the rural poor in mind and really cater to the needs and lifestyle of rural, impoverished people, especially farmers. For instance, the *mutuelle* insurance plan (not to be confused with Mutuals) is a community-based prepayment plan that has been enacted in several regions of Madagascar and allows patients to make small payments throughout the year. Their payments count toward a credit system, which goes toward covering medical expenses (Sharp & Kruse, 2011). Not only does this type of scheme foster financial

security, but it also encourages individuals to utilize services offered by health centers and to fulfill prescriptions.

Indeed, health insurance is limited and is not used by most of the people of Madagascar. However, *mutuelle* insurance schemes are promising. Although the very poorest of the poor may still be unable to meet the standards of the premium payment schedule, this system most resembles the core values cherished in the revival of traditional healers as a form of health care.

V. CHAPTER 4: REVIVAL OF TRADITIONAL HEALERS

When biomedicine became introduced to Madagascar, less emphasis was placed on traditional medicine, and the health care focus shifted to pharmaceuticals (Juliard et al., 2006). Thus, with the increasing costs of biomedicine and the increasing rates of poverty, particularly of the impoverished rural population, phytomedicines and traditional services have gained more and more recognition. Indeed, biomedicine can provide valuable services to a community, but if members of that community cannot afford the prescription medication or other treatments, these services cannot be used. Sometimes, Malagasy patients wishing to use pharmaceuticals purchase pills on the "parallel" market on a pill-by-pill basis (Nat Quansah, personal communication, 2011). Patients needing pills to treat malaria might purchase their medication in this way, ultimately leading to improper use of the medication. Alternatively, patients receive the free diagnosis from allopathic settings and then seek traditional healers with the diagnosis in hand in order to obtain safer and more affordable health care.

Indeed, treatments involving phytomedicines can avoid the dangers of misusing prescription medication or self-medicating. Using plants to treat a patient not only avoids these dangers, but it also is less expensive, and importantly helps to establish an important relationship between people and plants. This relationship is vital in traditional medicine, and is examined through the study of ethnobotany. The relationship between people and plants tends to be ignored in biomedicine, where technology and pills are used to care for patients. In fact, more emphasis is placed on the chemicals that can be derived from plants instead of the entirety of the plant, as seen in traditional medicine.

Considering the fact that approximately 25 percent of the active ingredients prescription medications are derived from plants, this relationship is by no means obsolete. Both types of medicine can offer valuable services to a population, but the economy, poverty rates and the government often dictate the nature of this relationship.

Recently, the Malagasy government has begun to give more recognition to the practice of traditional medicine. Codes from Queen Ranavalona II in the late 19th century remained a part of Malagasy law, making traditional medicine essentially illegal. However, several breakthroughs in the Malagasy government and its committees have attempted to return validity to traditional healers. The THA, the Malagasy Ministry of Health and Family Planning, and the Medical Association have adopted policies to integrate aspects of traditional medicine into the current health care system (Juliard et al., 2006).

Approximately 10,000 traditional healers currently practice in Madagascar, but only 500 are registered with the THA. By forming more relationships between traditional healers, biomedical doctors, and public authorities, traditional medicine has become more integrated into the biomedical health care system in Madagascar (Juliard et al., 2006). This increases the range of health care options by making it more comprehensive, and the regulation of traditional medicine, especially in rural areas, might increase the quality and reliability of care. In a country where nearly 70 percent of the rural population relies on traditional medicine, increasing reliability and accessibility of care through policies and commissions could greatly benefit these individuals (Juliard et al., 2006). By giving more

recognition to traditional medicine, the THA and Ministry of Health can help to legitimize traditional healers and their practice.

Another barrier to the revalidation of traditional medicine is the issue of exportation of plant material. Eighty to ninety percent of essential oils are exported, leaving a very low supply for the people who have traditionally cultivated medicinal plants and used them for centuries. Biomedicine has played a significant role in the country's health care, particularly in the development of *L'Institut Vaccinogène*, which helped Madagascar become the first colony to eradicate small pox in 1914. Additionally, the *Institut Pasteur* was formed in Antananarivo in 1927 as a subsidiary of the institute in Paris. The institute developed a vaccine with live versions of the disease and used the vaccine in human experiments in 1932 (Dr. Randria Narcisse, personal communication, 2012). Since the vaccine was distributed to the entire island, there was a large decrease in the number of cases, although the plague still remains a threat to the island today. However, despite the incorporation of allopathic medicine in Madagascar's history, the country's isolation and poverty has ultimately led individuals to rely on their own resources, helping to develop the rich traditional medicine that many people use in their daily lives (Juliard et al., 2006). Even when the royalty forbade the practice of traditional medicine, completely ridding traditional medicine from the minds of the people was not so easy. Because biodiversity holds such great value in the culture of Madagascar, there should be a larger focus on retaining more medicinal plants and their products domestically to stimulate Madagascar's own economy and directly help the impoverished Malagasy people. The very people who cultivate and live amongst these cherished medicinal plants cannot even

use them directly; for instance, much of the vanilla available in supermarkets has been exported, processed and packaged in containers, only to be shipped back to Madagascar. The issue of exporting most of Madagascar's medicinal plant material makes it much more expensive and inaccessible to the Malagasy people. However, export of plant material is not the only way in which Madagascar's precious biodiversity escapes the hands of those who most need them. Indeed, foreign pharmaceutical, research, and cosmetic companies all compete to acquire products of the rich biodiversity of Madagascar. The biopiracy usually involved in these endeavors to acquire medicinal plant material not only hinders the revalidation of traditional medicine, it also threatens the intellectual property of traditional healers who have been practicing medicine for centuries.

There are many advantages to preserving the domestic use of aromatic and medicinal plants. Directing funds towards domestic development of plant-based, medicinal treatments could stimulate Madagascar's economy so that more Malagasy people can participate in the economy and make more money, instead of having plant-based medicinal products being exported to foreign countries to be developed and produced.

Perhaps the best option to stimulate Madagascar's economy while simultaneously revalidating traditional medicine is the work of Malagasy research companies. These companies examine the biochemical properties of plants used by traditional healers in order to isolate the bioactive molecules. Traditional medicine does not conventionally have this pharmacological information available. This puts the work of traditional healers

into terms that go along with allopathic health care and biomedicine, and proves that traditional medicine does work, has value, and is an important resource for the Malagasy people.

Malagasy Research Companies

Le Centre National d'Application de Recherche Pharmaceutique (CNARP)

CNARP is a research facility located in Antananarivo. It was created in 1972 by the Ministry of Higher Education and Scientific Research; however, it did not begin functioning as a facility until 1977 (Rasoanaivo, 2006). CNARP is a public research facility, conducting research and producing medical products intended for local, Malagasy markets (Slotkin, 2011). CNARP uses plant-based traditional medicine as their primary source of information, and their research seeks to examine botanical, chemical, and pharmacological properties of plants used by traditional healers.

Employees of CNARP have written many articles about their work, explaining how biological compounds were isolated and whether or not these compounds can be used medically. In addition, CNARP release a list of medical products made by CNARP; each product is followed by the name of the plant from which the medicine is derived and what the medicine should be used for. Putting plants used by traditional healers under pharmacological study allows researchers to determine the biological activity of the plants and update their use with traditional healers.

At CNARP, research is conducted in five different departments: botany and ethnobotany; chemistry and extraction; pharmacodynamics; pharmaceutical technology; and clinical trials. The CNARP campus includes a laboratory in which to synthesize their

pharmaceuticals, a laboratory dedicated to malaria research and anti-malarial pharmaceutical development, an endangered plant garden (containing both *P. africanus* and *C. roseus*, among many others), and a room archiving hundreds upon hundreds of plants used in traditional medicine and by the facility. This archive room contains at least two dozen black filing cabinets filled with posters of the dried leaves, sticks, and/or flowers of each species of plant. The posters also contain the name of the plant, a description of the plant and where it is found, and which international or national organizations are collecting them or are involved in their research and the names of the articles in which the plants are referenced or studied.

Although the goal of research facilities like CNARP is to derive bioactive molecules from the plants, the research sometimes reveals that some plants used by healers contain no biologically active compound. CNARP relays this information back to the traditional healers, who then decide whether or not to continue to prescribe the plant. Many phytomedicines are actually a combination of several different plants, and one plant on its own may not have the same effect as when it is used synergistically. However, this suggests that there may be cultural underpinnings behind the use of these plants, besides merely scientific; their efficacy cannot always be explained through scientific measures.

Many partners work with CNARP to undertake this research, notably Madagascar's Ministry of Health and the Missouri Botanical Gardens from the United States, among many others from Madagascar and the global community. This type of research requires the development of stable relationships with traditional healers, given that traditional

medicine is their primary source of information for their research. Their work is much more than merely studying plants and manufacturing medical products; strong ethnobotanical relationships with traditional healers, plants, and allopathic medicine form the foundation and goal of CNARP. Without working directly with traditional healers, CNARP would not be what it is today. However, it can be difficult to identify biological compounds and make new medicinal products while simultaneously appropriating the knowledge of traditional medicine and medicinal plants to traditional healers.

CNARP tries to prevent biopiracy and strives to preserve the intellectual property of traditional healers by keeping such close relationships with them. But respecting the intellectual property of traditional healers becomes an issue when pharmaceutical companies exploit the biodiversity of Madagascar and nearly cause some plants to go extinct, including *Prunus africanus*, used to treat prostate cancer, and *Catharanthus roseus*, used to treat childhood leukemia. With traditional medicine as their main source of information, CNARP runs the risk of compromising the intellectual property of traditional healers. Many traditional healers use the same plants in their practice, and these plants have been used for hundreds of years, beginning with their ancestors. Therefore, properly attributing and preserving intellectual property can be ambiguous and difficult. However, just last year, the Ministry of Education and Scientific Research held a workshop for CNARP concerning intellectual property rights of the traditional healers they are learning and benefiting from so greatly. Looking at the surprisingly short list of medicinal products released by CNARP, one could conclude that most of their work goes toward elucidating biological compounds instead of manufacturing medical products to

make a profit, and is easily distinguished from foreign research companies exploiting the country's biodiversity and discrediting traditional medicine.

C. roseus (common name: rosy periwinkle) is a plant cherished by CNARP, and has been researched extensively by both Malagasy and foreign research companies. Its use by traditional healers for hundreds of years is scientifically validated by an abundance of literature explaining the health benefits of the multiple bioactive compounds found in its different parts. C. *roseus* contains alkaloids, which are important secondary metabolites produced by plants. Specifically, the rosy periwinkle provides more than 130 bioactive terpenoid indole alkaloids, or TIAs (Verma, Mathur, Srivastava, & Mathur, 2012). The alkaloids called vinblastine and vincristine are proven to have important clinical value in treating cancers such as leukemia and Hodgkin's lymphoma in the form of chemotherapies; vincristine has been used to increase leukemia survival from 10 percent to 95 percent, while vinblastin is used to treat Hodgkin's lymphoma. However, the biomolecules of *C. roseus* present a problem to researchers because of the difficulty in artificially synthesizing vinblastine and vincristine (Loyola-Vargas, Galaz-Avalos, & Ku-Cauich, 2007). More than 50 metabolic steps are necessary to produce these important alkaloids, and only 20 of the 50 enzymes needed to produce them have been determined (Loyola-Vargas et al., 2007). Compounding upon the difficulty in producing synthetic substitutes is the fact that a low proportion of the molecules in the plant actually are TIAs; synthetic substitutes are unavailable; and the cost of TIAs is great (Verma et al., 2011). The market for *C. roseus* has reached $200 million per year because of the high demand of the alkaloids and their promising therapeutic effects.

Over 350,000 plant species are known, and between 35,000 and 70,000 are used for medicinal purposes; however, less than 0.5 percent of these medicinal plants are researched for their bioactive compounds (Shasany, Shukla, & Khanuja, 2007). Twenty-seven percent of the known plant species in Madagascar have medicinal value, which far exceeds the percentages of other countries of south-east Asia and the Indian subcontinent (Table 1). Only 100 plant species are used in the 25 percent of pharmaceuticals that are derived from plants (Comer & Debus, 1996).

Country	Plant Species	Medicinal Plant Species	Percentage with Medicinal Value
China	26,092	4,941	18.9
Madagascar	**13,000**	**3,500**	**27.0**
India	15,000	3,000	20.0
USA	21,641	2,564	11.8
Thailand	11,625	1,800	15.5
Vietnam	10,500	1,800	17.1
Malaysia	15,500	1,200	7.7
Indonesia	22,500	1,000	4.4
Philippines	8,931	850	9.5
Nepal	6,973	700	10.0
Sri Lanka	3,314	550	16.6
Pakistan	4,950	300	6.1
Average	13,366	1,700	12.7
World	422,000	56,385	13.64

Source: http://www.fao.org : Biodiversity and Ecosystem Approach in Agriculture, Forestry, and Fisheries; IK Notes 91, World Bank, April, 2006.

Table 1. Prevalence of medicinal plants in select countries (Juliard et al., 2006).

As impressive as it is that a plant as seemingly insignificant as the rosy periwinkle can treat leukemia and lymphomas, *C. roseus* in fact contains bioactive molecules to treat much more than just these two diseases. Its roots contain ajmalicine and serpentine, compounds used in treating high blood pressure and other cardiovascular issues such as to arrest bleeding. The shoot contains the ever-important bisindole alkaloids mentioned earlier that are used in anticancer chemotherapies. Other alkaloids are used to lower

blood sugar levels to help manage diabetes (Shasany et al., 2011). Currently, the micro RNAs (miRNAs) of the rosy periwinkle are being studied for therapeutic value, and seven miRNAs have been found to hybridize with targets of signal transduction and apoptosis (Omer, Singh, & Duhan, 2012). These targets may be important in preventing and treating not only leukemia, but also arthritis and Alzheimer's. The pharmaceutical value of this small, pink-flowered plant, found only in Madagascar, has an invaluable influence in the drug market.

***L'Institut Malgache pour la Recherché Appliquée (IMRA*)**

In 1958, IMRA was created as a non-governmental organization by Professor Albert Rakoto-Ratsimamnga, who played a very important role in the development of scientific research in Madagascar (Rasoanaivo, 2006). Now, IMRA is recognized as a foundation by the Malagasy government, so it does receive some governmental funds. Rasoanaivo (2006) states the following about IMRA:

> "IMRA is by far the best equipped centre in Madagascar for biodiversity conservation and drug discovery from natural products, and has a strong network of collaborations with western institutes. IMRA is a good example on how scientific research could be integrated with health care, conservation, and production."

IMRA is made up of three departments: the department of research; the department of production and export; and the department of clinics. The department of research analyzes biomolecules of plants, particularly in regard to malaria, cancer, diabetes, immunomodulation, and cardiovascular and respiratory diseases (Rasoanaivo, 2006). Meanwhile, the department of production and export is responsible for producing 40 plant-based drugs ("phytomedicines"), cosmetics, and other products specifically

designed for local markets at affordable prices. However, IMRA does export medicinal plants such as *Centella asiatica* and *Drosera ramantacea*, as well as essential oils for commercial use in return for profit (Rasoanaivo, 2006). Finally, the department of clinics is responsible for consulting nearly 30 patients per day. These patients may receive phytomedicines and/or biomedicine as part of their treatment.

Notably, since its conception, IMRA has documented over 6,000 plants and their ethnomedical uses, beginning with the development of a diabetes supplement called Madeglucyl by Professor Rakoto-Ratsimamanga, the organization's founder (Puri et al., 2010). IMRA's efforts have combined the fight against bioprospecting, particularly the exploitative biopiracy; the conservation of biodiversity; dedication to producing affordable medicine for the Malagasy people; and the re-valorization of traditional healers.

Homeopharma

Homeopharma is a private company, founded in 1992 by Dr. Jean Claude Ratsimivony. This company specializes in homeopathy, phytotherapy, and aromatherapy (plant-based soaps, anti-insect candles, massage creams). Homeopharma is widely available for local use, which was apparent to me in Madagascar when I saw Homeopharma stores almost every other block. One Homeopharma store was even located in one of the hospitals we visited. Homeopharma uses over 1500 plants in their products ("Homeopharma: Laboratoire Physique de Madagascar," 2011).

Homeopharma's slogan is "Sante, beauté, bien-être… au quotidien," which translates to "Health, beauty, well-being…daily." This company is much more

commercialized than CNARP and IMRA. As is clear from their slogan, the goals of Homeopharma are obviously not solely to isolate bioactive compounds for the benefit of traditional medicine, but their work and research is invaluable in documenting bioactive and therapeutic properties of plants.

Traditional medicine is engrained in the family history of the founder of Homeopharma. The great-grandfather of Dr. Ratsimivony was a traditional healer and astrologer in the 19th century; his grandfather was a doctor who practiced in remote areas of Madagascar and actually incorporated herbal medicine in his practice. Therefore, traditional knowledge and the support of traditional healers are incorporated into the philosophy of Homeopharma by its very history.

Societé de Transformation Malgache et d'Exportation (SOTRAMEX)

SOTRAMEX is a private business that receives plant material from collectors in order to create essential oils from distillation and extraction. None of their products or research is available to the local community, although during our tour they claimed to have built twenty primary schools country-wide and managed local initiatives such as providing safe drinking water (Slotkin, 2011). SOTRAMEX is a member of the Union for Ethical BioTrade, founded in 2007. This is a non-profit organization promoting respect for biodiversity as a source of medicine and of traditional knowledge, to "assure the equitable sharing of benefits all along the supply chain." Members must commit to conduct their companies ethically in accordance with Ethical BioTrade principles to ensure benefits reach all appropriate parties and to protect traditional knowledge. This helps to re-valorize traditional healers and their wisdom ("Union for Ethical Biotrade,"

2011).

Although SOTRAMEX does not work directly with traditional healers and have more of a business, profit-making mindset, work is still done to preserve the source of their plants essential oils. As Juliard et al. (2006) suggest, this is a very important aspect in the development of Madagascar's aromatic and medicinal plant industry. The success of companies such as SOTRAMEX, IMRA, and CNARP is absolutely dependent on the protection of medicinal plants and their sustainable use. The producers and collectors of plant materials are at the bottom levels of this market, and are often easily exploited, if not ignored. These members are the least integrated into the rights and benefits of the system. However, it is imperative that these members of the market are educated about biodiversity and sustainability, just as the downstream actors are educated. Downstream actors such as SOTRAMEX might even use sustainability as a marketing scheme to create their brand qualities, but without providing education and support to the original actors, sustainability and appreciation of biodiversity cannot be achieved. Providers and collectors are the source of plant material to all of the downstream actors, and SOTRAMEX demonstrates the valuable presence of these actors by becoming involved with the Union for Ethical Biotrade.

SOTRAMEX receives the plant material from local collectors, who are paid at least 500 Ariary per kilo of plants, or $0.25. However, the plant collectors could be paid more depending on what plant is collected (Slotkin 2011). The collectors are paid a daily salary of 5,000 Ariary, or approximately $2.50 (Slotkin 2011). SOTRAMEX dries the plants, distills them, and extracts essential oils. This facility does not perform research unless it

is requested by their clients; instead, SOTRAMEX deals solely in extracting plant oils and other plant products to export them to foreign companies, including Bayer and L'Oreal. This business predominantly chooses to use plants that are desired by or undergoing research by their clients and less frequently works with local traditional healers. They must acquire permits in order to collect plants, especially if the plants are located in a protected forested area. In addition to extracting essential oils to be used in pharmaceuticals, SOTRAMEX also produces cassava flour and industrial wax to be used in the textile industry ("SOTRAMEX," 2011).

Reflections on Visits to Traditional Healers

My experiences in Madagascar showed me that the attitudes of traditional healers differ compared to the attitudes of allopathic health care professionals. In the United States, there is a large discrepancy between allopathic medicine and homeopathic medicine. However, in Madagascar, even the allopathic doctors are willing to work with the traditional healers; this collaborative spirit came from the traditional healers in an even stronger way. As I discovered during my interviews with the traditional healers, they were all more than willing to work with allopathic medicine if the opportunity arose. It seems that in western medicine, a business mindset is adopted more often than the mindset with the patient's health being the primary goal. This collaborative and service-oriented outlook was shared by all traditional healers I visited in Madagascar (except for, possibly, the *mpiskidy*). A very small price (amounting to five American dollars at the most) was required for most of the healers' services. But, if the patient couldn't afford the price, many healers were willing to receive payment in other forms. For instance, one

reninjaza (birth mother) in Andasibe told us that if her patients could not pay with money, she would accept items in groups of twelve, because she believed the number to be sacred. Mama Bozy, an herbalist, said that once money becomes the main goal as a traditional healer, that person is no longer a true traditional healer. I have realized that in traditional medicine, this out look has fostered a much larger sense of service and a real longing to help the community as opposed to most allopathic medical settings.

In the discussion of preserving biodiversity, it is important to distinguish the difference between conservation and preservation. It may seem as though the best way to protect traditional medicine from exploitative encounters would be to prevent anyone from accessing the forests in which they are found in order to exclude any possibility of maltreatment to the plants. However, this preservation also prevents traditional healers from accessing these important plants. Instead, sustainable use should be encouraged so that the plants can be both protected and cultivated. Conservation of forests containing medicinal plants does not mean that these forests are completely closed off; preservation must be avoided, and conservation and sustainable use should be the norm. This would foster the desire to engage in the proper management of the life-saving relationship between humans and plants – in both directions.

The issue of biopiracy should also be addressed in regards to both the preservation of biodiversity and the preservation of traditional medicine. Biopiracy compromises the intellectual property of traditional healers and the culture of medical knowledge in Madagascar. Because there are so many types of traditional healers, and the history of traditional medicine reaches so far back in Madagascar's history, there is a

problem with adequately protecting the intellectual property of healers, especially when research facilities test plants and their different components to extract the active molecule claimed to heal, most often in an exploitative manner. However, by conducting research within the context of culture, domestic research facilities of Madagascar (such as CNARP an IMRA) are at the very least recognizing the fact that the knowledge of the life-saving qualities of these plants come not only from the biodiversity of Madagascar, but also from the rich history of traditional medicine and from the knowledge and expertise of traditional healers.

Additionally, the treatments created by traditional healers do not only include one plant, but often constitute a combination of different parts of various plants that must be prepared in specific ways; the herbal aspect of traditional medicine is much more than just plucking a plant from the forest and giving it to the patient. The root, shoot, bulb, tuber, stem, bark, flower, sap, and various other parts of the plants are incorporated into the treatment. These plant parts can be prepared through cold infusions, hot infusions, crushing, or distilled and mixed with lard to form an ointment or cream, and can be ingested orally, anally, through inhalations, and through steam baths (Nat Quansah, personal communication, 2011). The intricate ways in which these plants must be acquired, prepared, and administered are the results of hundreds of human application, making up the rich history of traditional medicine.

VI. CHAPTER 5: INTEGRATIVE MEDICINE

Although traditional medicine can help to solve many issues of affordable health care, there are some parts of health care that traditional medicine cannot address on its own. These include emergent care and cases in which pharmaceutical drugs provide the only effective treatment for patients. By synergistically combining the strengths and the values of both traditional medicine and allopathic medicine, integrative medicine and integrative health care systems can be a promising solution to the issues with Madagascar's current health care systems. The integrated health care system (IHCS) uses and develops peoples' ethnobotanical relationships with plants and biodiversity, with the goal of health care and medicinal use. The IHCS offers a way to address economic, biological, and cultural aspects of the village or community (Quansah, 2001). Although the IHCS outlined below was designed with the ethnobotanical history of Madagasar in mind, it can easily be adapted to other impoverished countries with inadequate health care systems and a history of traditional medicine, even if their biodiversity is not as immense as Madagascar's. As long as the focus remains on the pillars outlined below, the IHCS can theoretically aid the health care situations of other countries, as well.

According to Quansah (2001), there are several central pillars to the success of the IHCS. The first of these is conservation. Sustainable use is at the heart of the conservation goals in this system, so that the plants and other resources used in the system can continue to be available and respected for their life-saving qualities. Although the conservation of plants is definitely important, the conservation of culture is also emphasized in the IHCS. The establishment and development of peoples' ethnobotanical

relationships with plants is vital in the preservation of the village's culture and of the propagation of traditional medicinal plant knowledge. The sustainable use of medicinal plants would also allow patients to bypass the many issues involved in acquiring drugs through the current drug supply system. As mentioned earlier, the process of fulfilling purchase orders and finally providing the drugs to the district pharmacies can take as long as a month. If treatments involved medicinal plants found in the nearby forests or even medicinal plant gardens found next to the clinic itself, patients could watch their plant prescription be prepared and receive it on the same day of diagnosis. The issue of drug leakage would no longer exist, eliminating much of the corruption involved in the system.

The second pillar of the IHCS is the concept of a relay team, comprised not only of the traditional healer and allopathic doctor who see patients, diagnose them, and prescribe traditional plants for the patients together, but also of each individual in the community. The IHCS harnesses the diverse capabilities of each person to ensure the success of the integrated health care facility (Quansah, 2001). At the heart of the IHCS relay team is respect and confidence in one another's abilities; without the contributions and successes of each person, the IHCS will not be successful. This takes form in the combined effort to conserve the medicinal plants found in the community. Community members must be independent in their responsibility to do their tasks, but also dependent on the success of others. The most immediate threat to his effort is the use of slash-and-burn agricultural techniques, in which owners of rice paddies burn down forests in order to make room for rice fields. Because of these techniques and other threats,

approximately 75 percent of the natural forest in Madagascar has been destroyed, thereby destroying untold numbers of plants with possible and unknown medicinal use. Slash-and-burn techniques are a major threat to efforts to conserve biodiversity in Madagascar (Nat Quansah, personal communication, 2011).

Another pillar of the IHCS is that local resources, both material and human, must be pursued first before using any external resources. According to Quansah (2001), using external resources without first pursuing what the local members and materials of the community are capable of forces people to rely too heavily on these outside resources, and causes them to think they are incapable of doing things for themselves, effectively "turning people (countries) into beggars." This does not condone sustainable use whatsoever. The invaluable power of the relationships formed in the IHCS and the development of personal capabilities is lost when the community blindly relies on alternatives to resources they have locally; being able to harness these resources in a positive way serves to benefit the entire community. The diversity of not only the plants but of the strengths and capabilities of individuals should be exhausted before pursuing outside resources to complement – not replace – the local resources.

The IHCS is a multi-disciplinary entity. It harnesses the resources of both traditional and allopathic health care systems to produce a complete, synergistic system of health care. The traditional healer and the allopathic practitioner practice together in the integrated health care system, meeting with patients together, diagnosing them together, prescribing medicine (either plant-based or pharmaceutical products) together, and even preparing the medicinal plants together, in front of the patient. This encourages

the patient to be active in their own care (Snyderman & Weil, 2002), and encourages them even further to protect the biodiversity around them. Making patients active in their own care, which is based on the life-saving qualities of biodiversity, further emphasizes the importance of conservation, one of the pillars of the IHCS. Not only different health care systems, but various specialists are included in this system: ethnobotanists, biochemists, and pharmacologists are central to the success of the system (Quansah, 2001). Ultimately, these pillars contribute to the main goal of IHCS: "Health for all and health of all: healthy people, healthy biodiversity, healthy environment, healthy culture, healthy economy" (Quansah, 2001).

Le Clinique de Manongarivo: A Model of the IHCS

In 1993, Quansah helped to establish an integrative health care center in the Ambodisakoana Village in Manongarivo, located in northwest Madagascar. The clinic was made up of a traditional healer, an allopathic practitioner, ethnobotanists, and a laboratory team of biochemists, chemists, and pharmacologists (Quansah, 2001). Working as a relay team, the traditional and allopathic practitioners worked together to receive and diagnose patients, as mentioned earlier. Unlike the practices of traditional medicine alone, medical records including patient information such as the clinical examination and treatment were kept, and two copies were made; one for the clinic, and one to be sent to the laboratory team. This provided a higher quality of care during follow-up visits, which took place either at the clinic or in the patients' homes, which the traditional and allopathic practitioners would visit. Pharmaceutical drugs were used only when local traditional remedies were not available in order to exhaust the community's

resource options and to prevent the heavy reliance on pharmaceutical products and technologies. When pharmaceutical products were used, they were used in a way to complement the local resources (Quansah, 2001).

The traditional plants prescribed to the patient were either prepared in their presence or in the presence of the patient's guardian or accompanying person. This not only served to strengthen the patient's realization of their reliance on biodiversity, but also to avoid the dangers and harms of misusing medicinal plants and pharmaceutical products alike. All treatments types were outlined for the patients. The belief that traditional healers use imprecise dosages, which contribute to traditional medicine's apparent imprecision and lack of certainty, is used to discredit traditional medicine. However, the clinic addressed this issue by preparing the plants in front of the patient, emphasizing the frequency and duration of treatment. This would also help to eliminate waste and further solidify the sustainable qualities of traditional medicine. Out of the 40 different diseases presented at the clinic, 32 were treated effectively with only the use of medicinal plants, including herpes, lock-jaw, indigestion, hypertension, asthma, and gonorrhea. Two were best treated with only pharmaceutical products, including acute bronchopneumonia and typhus fever syndrome. The final six were effectively treated using both medicinal plants and pharmaceutical products, including cough, genital ulcers, syphilis, malaria, and wounds with complications (Quansah, 2001).

The clinic harbored a medicinal plant garden containing 30 different species. This was established in hopes of promoting sustainable use of plants found in the forest surrounding the community. Other sustainable outcomes of the clinic include the fact that

the laboratory found that using the leaves of a *Burasaia* spp. to treat fever was more effective than using the roots of the plant as had been traditionally practiced by traditional healers. Additionally, the oil of a *Mauloutchia* spp. was found to treat toothaches and sore gums more effectively than using the bark, as had been prescribed in the past. These conclusions minimized waste and promoted the sustainable use of the plant, only using the parts of the plant which were most effective at treating the illnesses.

The IHCS confers affordability, accessibility, and personal responsibility to the cost-effectiveness of the whole system. Using local medicinal plants is free of charge or five to ten times cheaper than pharmaceutical drugs, allowing the community to reduce their health care costs drastically. Saving money on health care in this realm enabled them to have more funds available for purchasing pharmaceuticals or using biomedical technologies when absolutely necessary.

Although there are many benefits to using integrative health services, some areas still need to be addressed. These include emergent care, in which access to an allopathic health center is absolutely necessary, which is difficult for the village containing the clinic, because such a health care center is 80 km away. Theoretically, the integrative health care centers should be equipped enough with phytomedicines and pharmaceuticals to address any situation involving emergent care, but rural development has much to do with the center's success in this regard. Additionally, protecting intellectual property rights of traditional healers is addressed through the integrative health care system, especially through the work of the laboratory team to examine the efficacy of and to elucidate the bioactive molecules of the plants used by the traditional healers; however,

the importance of these efforts cannot be emphasized enough. Besides providing more adequate care for the Malagasy people, the goal of the IHCS is to validate traditional medicine so that traditional medical knowledge can be passed on to future generations. Recruiting allopathic doctors willing to work in rural areas in the fashion of the IHCS is also a challenge to the development of integrative health care, and rural development has a large area of influence regarding this, as well.

Another hindrance to the success of the IHCS is that if community members and health care professionals become too concerned with making a profit, the system is doomed to fail. A disproportionate focus on financial gain causes members to lose focus of the need to work together and depend on each other in a service-oriented manner. In the IHCS, the health of the patients, conservation of biodiversity, and reaffirmation of culture are the main goals of the IHCS; financial gain is not. If some community members lose focus on these goals, the effects of this loss of focus are felt all throughout the system and can affect the stability of the relay systems. The service-oriented principles of traditional medicine should be preserved in the IHCS, based on a real desire of community members to strive towards the betterment of their community. Healthy community members help create a stronger community as a whole, and can work toward the health of all members. This is carried out by utilizing the new-found ability to channel time, energy, and worries that would have gone into trying to reach proper health care and put it into other parts of the community that need to be addressed, such as education, food, going to work, building roads, etc.

Applying IHCS Principles to Allopathic Medicine

Several qualities of the traditional healers of Madagascar struck me during my study abroad experience. First of all, the ability of the patient to pay for the services of the healer or for the plants prescribed rarely seemed to be an issue; the first and foremost goal was the health of the patient. This urgency of desire to heal the patient is also evident in their willingness to work with allopathic doctors in the diagnosis and healing process. This sense of genuine service to their community is what drives the lives of the traditional healers. In the western world, where allopathic is the norm, these qualities do not necessarily apply – at least not to the extent as the traditional healers. More often than not, the competition involved in the health care industry, especially in the United States, does not encourage or allow qualities such as these to take root.

In addition to competitiveness, the cost of health care in the United States is also an issue. By incorporating integrative health care, or at least herbal medicine, into the current allopathic system, patients will save an exorbitant amount of money while also learning how to use the environment sustainably. Using herbal medicine and the qualities of the integrative health care system will allow patients to save money on expensive pharmaceuticals and procedures. By integrating the two health care philosophies in this way, patients will no longer have an "either-or" option, but a "both-and" option, allowing them to get the most out of their health care.

Finally, If only 0.5 percent of medicinal plants are being studied, then one could conclude that there are many other medicinal plants that could be used in the IHCS to expand the repertoire effective treatments. The development of the IHCS in rural areas could spread to urban areas, and would encourage the research of other unknown

medicinal plants to further incorporate phytomedicines into IHCS, and therefore into allopathic medicine. This research would even further validate and strengthen traditional medicine and therefore the IHCS as a valid mode of health care. If the Ministry of Health in Madagascar effectively supported and encouraged IHCS and integrated health facilities, then research of countless numbers of medicinal plants could go underway, and could even increase the repertoire of pharmaceuticals as well. The most important lesson to remember, however, is that these plants are parts of ethnobotanical relationships and form the basis of health care for many impoverished people. By tying biomedical research of plants to the ethnobotanical relationships from which they arose, traditional medicine can be revalidated, the intellectual property of traditional healers can be protected, and biodiversity can be sustainably used so that these plants can continue to be used in the future. The integrative health care system, if properly funded and respected, has the potential to revolutionize the state of health care for the rural poor not only of Madagascar, and not only of traditional medicine, but the state of health care for the global community.

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