Best Practices for Lead Poisoning Prevention in Urban Bangkok Communities

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Submitted to

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Abstract

Thai citizens are susceptible to detrimental health problems caused by prolonged exposure to lead-based paint. Our project examined methods available for use in lead poisoning prevention in vulnerable Bangkok communities. By reviewing scientific literature, and conducting interviews with Thai contractors, surveys of teachers, parents, and local community members, and observations of practices at child-care centers, we established appropriate ways to implement a prevention campaign for stakeholders in Bangkok. We presented a set of practical recommendations employing audio, visual, and written media sources. These methods of prevention were given to our sponsor, the Duang Prateep Foundation, an organization known for their leadership programs concerning the welfare of local communities.

Executive Summary

Developing nations face numerous social, humanistic, and technological challenges in managing the transition from an agricultural to an industrial economy. As a result of both the multitude and range of these problems, many are not fully mitigated until they have become widespread, leaving subsequent long-term and complex consequences. With a rapidly growing industrial economy, Thailand is one such country dealing with these repercussions. The rapid development, primarily occurring in and around the capital city of Bangkok, has been facilitated by lenient environmental regulations. This lack of stringent environmental controls has created a situation in which harmful substances are potentially introduced into private homes and public buildings. Lead is one of the most prominent of these dangerous materials.

One way lead compounds are directly introduced into human surroundings is through oil-based paint. Oil-based paints are commonly preferred over water-based paints because they are lower in cost, more durable and have better color retention; these qualities are due to the high lead content. The prevalence of lead-based paint, in combination with a lack of knowledge regarding the dangers of lead, has placed Bangkok residents at an increased risk of contracting lead poisoning.

Particularly detrimental to children, lead poisoning develops over time through ingestion and inhalation. Lead primarily inhibits development of the nervous system; effects range in severity from inattentiveness to permanent nerve damage. It is hence critical to take measures to prevent the initial incidence of lead exposure and ingestion among youth.

Worldwide, many nations are taking proactive measures to prevent lead poisoning. In particular, the United States is recognized for its detailed standards and laws regarding lead exposure. Thailand, in contrast, has only started to develop lead content standards in consumer products. However, these standards are currently only non-mandatory guidelines. In addition, Thai ministries have not established standardized procedures for lead-based paint removal, which may potentially cause increased lead contamination.

Within Bangkok , the socio-economic conditions of the 80,000 people of the Klong Toey slum distinguish it as a vulnerable community in terms of increased possibility of lead poisoning. The Duang Prateep Foundation works within Klong Toey as a civic leader towards community self-development by supporting the people with education, health and childhood care. Today it faces a dangerous case of lead contamination in its own nursery.

In 2007 the Child Safety Promotion and Injury Prevention Research Center conducted a district wide lead testing project in Bangkok. High levels of lead were specifically detected in multiple schools, including a Klong Toey nursery of the Duang Prateep Foundation. In order to mitigate the problem, the Duang Prateep Foundation independently hired a private contractor to remove the contaminated paint.

After these initial remediation efforts, the nursery was retested in 2009; testing revealed that the lead level had increased significantly. This surprising increase in lead levels prompted the Foundation to seek a solution. The Foundation is planning to must take proactive measures to remediate any contamination, but also recognizes that lead may be widespread within the communities they serve. Our team assisted the Foundation by reporting on the best practices of lead-based paint remediation and proposing means to prevent lead poisoning.

Methodology and Results

The team completed four objectives: the first two comparatively analyzed the best practices of prevention by remediation and by education, through research and interviews. We then completed an assessment of local attitudes towards and knowledge about lead. Lastly, various awareness campaign strategies were evaluated, in addition to educational methods used at the Duang Prateep Foundation. These final two objectives were completed though research and supplemented with public surveys, interviews and observations.

In completing our objectives, we found that prevention of lead poisoning is most effectively based on reducing exposure to lead sources, specifically lead-based paint. This can be achieved through primary and secondary prevention methods. *Primary* prevention is achieved through legislation prohibiting the introduction of lead into the environment. Our group held a meeting with the Bangkok Metropolitan Administration (BMA) at the conclusion of our project to discuss implementing our recommendations on a proper policy level. However, due to the current prevalence of lead-based paint in communities throughout Bangkok, we focused mainly on identifying appropriate *secondary* prevention methods, working to both remediate the contaminated sites and educate the public about ingestion prevention methods.

In its practices of lead-based paint remediation, the United States is often noted to have the best abatement policies; our assessment also focused upon the practices of Australia because the contamination there was similar to the contamination in Thailand. We then set out to evaluate local Thai contractor practices and knowledge regarding proper lead remediation. Interviewed contractors acknowledged the health risks of lead exposure, but did not fully understand the dangers of improper lead-based paint removal procedures. Ineffective and unsafe practices were largely due to a lack of understanding and limited budgets.

Equally important in minimizing lead poisoning are increased awareness of "lead-safe" practices and emphasis on proactive prevention methods. Campaigns about lead poisoning prevention should be based on the established best practices, the socio-economic context of the target audience and their general awareness about the problem. The Duang Prateep Foundation's role in the Klong Toey community makes it an important source to educate citizens in preventing lead poisoning.

The best methods to communicate lead poisoning prevention practices vary according to the target audience. There are two important target audiences for a successful mitigation campaign, the Thai government and the general public. Within the general public, we identified two groups at an increased risk of contracting lead poisoning, current Thai contractors and children in nursery schools.

The general public is familiar with lead but generally misinformed about lead sources and the means and symptoms of poisoning. Additionally, a portion of the Klong Toey community is illiterate, indicating that visual and audio-based media was the most effective means of communication. Parents and teachers at the Duang Prateep Foundation demonstrated strong concern for their children and invested interest in learning more to protect their families. The teachers also recommended interactive activities to teach hygiene practices to the young students. Educational programs for the teachers, in addition to the parents, were suggested to protect the vulnerable children.

Analysis and Conclusions

Since Thai contractors and the general public were identified as target audiences, we applied our findings directly to them.

The typical processes followed by contractors when removing lead-based paint do not meet the standards set by the United States' best practices. There was a demonstrated lack of awareness and limited interest by the interviewed contractors to follow such best practices, largely due to lack of knowledge and cost. As a result, an emphasis on occupational safety and effective remediation is needed.

For the general public, a comprehensive awareness campaign of occupant safety will lower lead intake and is therefore critical to prevent lead poisoning. Increased awareness within the community is important to empower residents to protect themselves. An educational program for the general community of Klong Toey, emphasizing audio and visual learning, will be effective in preventing lead exposure and ingestion.

To specifically protect the children in the affected Duang Prateep Foundation nursery, information needs to be directed to the teachers and parents of the students. By means of seminars, posters and pamphlets, the target audiences can best be educated on lead-safe practices. The children, though young, can be empowered to protect themselves from lead ingestion through a variety of hygiene games.

Our findings indicate that the best way of eliminating environmental lead sources, specifically lead-based paint, is ultimately to remove the risk of lead poisoning. Because this process occurs over an extended period of time, community members must protect themselves until preventative legislation and remediation is successfully accomplished. It was also necessary to enable community members to protect themselves while the legislation and remediation progresses. A campaign to raise knowledge and awareness, and therefore provide proactive means of minimizing lead ingestion, was determined to be most effective and applicable to the case of Klong Toey. The Duang Prateep Foundation, as an influential organization both on a political and local level, can act as the pivotal source of information from which different groups within the community can be integrated into this awareness campaign.

Recommendations

Based on these conclusions, we proposed the following recommendations to the Duang Prateep Foundation.

At the public policy level of primary prevention, the Duang Prateep Foundation was supplied with an abridged version of our overall report to appeal for government action concerning the matter of lead-based paint abatement. Additionally, we suggested that the Foundation draft a newspaper article detailing the problems of lead contamination and lead poisoning, as well as take a leadership role by offering its services to citizens who seek further information. We also advise that the Foundation continue to hold meetings with appropriate ministries within the BMA to ensure the issue of lead contamination remains a concern of governmental officials.

To reach out to the general public, we proposed that the Foundation make a public announcement concerning lead over the local intercom system during the broadcasted news in Klong Toey. We also suggested the Foundation communicate to Klong Toey lead-safe information through posters, visual pamphlets, awareness seminar and youth-directed puppet show. We finally advised the Duang Prateep Foundation to create a page on their website that presents information about lead-based paint.

To address the contracting industry, the Duang Prateep Foundation should communicate both proper standards for lead-based paint removal and the health risks of lead contamination to contractors through a seminar. We also recommended providing contacts and professional resources through which contractors could find further information.

We recommend that the Duang Prateep Foundation raise awareness among teachers and parents by conducting a seminar highlighting the health effects of and prevention methods against lead poisoning. We recommend the Foundation further communicate these prevention measures in the school and to the students' by displaying picture-oriented posters, developing a video and creating pamphlets. The Duang Prateep Foundation should make health contact information available to teachers and parents in the case of possible poisoning. Directly communicating with the students is critical to protecting them, for instance by using puppet shows and games to reinforce lead-safe hygiene.

The Duang Prateep Foundation should pursue proper lead-based paint removal methods promptly by verifying that the contractors hired are certified to safely and effectively remove lead-based paint. The Foundation was also advised to immediately act to protect the walls from abrasive activity that may further the flaking and dispersal of paint particles. Additionally we recommended that the Duang Prateep Foundation continue to use lead-free paint that meets the national lead standards and encourage surrounding nurseries to follow in their footsteps when repainting kindergartens.

Summary

Thai citizens face potential serious health problems resulting from the introduction of lead into the environment. Lead poisoning is contracted through prolonged exposure to industrial lead contaminants such as lead-based paint, and poses an increased threat to high-exposure populations, including children and construction workers. The Duang Prateep Foundation's nursery in Thailand's urban slum of Klong Toey, Bangkok, is only one of many examples of the dangerous contamination cases prevalent throughout Thailand. Although lead exposure has already occurred, lead poisoning can be prevented through both proper remediation and educational about lead-safe hygiene. The situation at the Duang Prateep Foundation's nursery gives the Foundation the opportunity to raise awareness regarding the dangers of lead and to promote community-based educational programs on lead poisoning prevention. Focusing on these goals, the Duang Prateep Foundation should head a lead awareness campaign geared towards lead poisoning prevention by promoting proper lead paint removal practices and increasing public knowledge regarding lead. In meeting with the BMA, we were honored to have assisted the Foundation in an initial effort to raise legislative awareness about and promote against lead contamination (see figure below). Through the influence of the Foundation, this new campaign can both empower communities throughout Thailand to protect themselves from lead poisoning and encourage legislative action toward permanently eliminating lead contamination within urban Bangkok communities.

Group presentation to the Bangkok Metropolitan Administration advocating the development of public policy regarding lead based paint

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BSAC-Bachelor of Science in Applied Chemistry

CDC-Center for Disease Control and Prevention

BLL-Blood Lead Level

BMA-Bangkok Metropolitans Administration

EDTA- Ethyldiaminetetraacetic acid

EPA-Environmental Protection Agency

EU-European Union

HEPA-High Efficiency Particulate Air

PPE-Personal Protective Equipment

ppm-parts per million

RRP-Renovation Repair and Painting Rule

UNEP-United Nations Environment Program

XRF-X-Ray Florescence

Chapter 1: Introduction

Developing nations face multiple social, humanistic, and technological challenges in managing the transition from an agricultural to an industrial-based economy. Because this transition, as seen in Thailand's recent urbanization, can be unexpectedly rapid, both governmental agencies and communities are often under-prepared for managing the unforeseen problems of development. These issues commonly result from a lack of knowledge concerning the operations and impacts of the new industries on the society and environment, and subsequently create a wide range of various issues and concerns arising in local communities. As a result of the number and range of problems, these negative impacts of urbanization are frequently not fully mitigated until they have become widespread problems that receive public criticism. Furthermore, a number of these effects have recently been exacerbated by the unexpected severe flooding of the 2011 rainy season. One such pressing issue is lead-based paint contamination in Bangkok.

With the growth towards a manufacturing market, Bangkok has surpassed other regions of Thailand in its rapid rate of both urbanization and industrialization (Hussey, 1993). Changing conditions in the global economy, along with the support of the government, have promoted this industrialization and concomitant urbanization. Unfortunately, lenient environmental regulations concerning hazardous industrial wastes, particularly lead-based paints, have been allowed by developing nations to promote this economic growth.

Oil-based paint is commonly used throughout the world due to its durability and low price. However, this type of paint often contains high levels of the toxic heavy metal lead. Lead can be easily spread into the surrounding environment because of the prevalence of lead-based paint in Bangkok, many Thai citizens, particularly children, are either at risk for or currently experiencing physical and mental health problems resulting from continuous exposure to lead contamination. Further contributing to the problem, the majority of Thai contractors and citizens are either unaware or misinformed about these dangers, and thus cannot take adequate measures to protect themselves and their communities.

Although the Thai government has enacted a number of regulations and standards pertaining to lead in the paint industry, many of these are not mandatory policies, but rather recommended guidelines that manufacturers can choose to disregard. Additionally, there are no governmental regulations on remediation or removal processes used for lead-based paint, further expanding the risks to public health. Because government policy currently shows little interest in advancing these laws and regulations (Wayapoj, 2012), it is critical that the dangerous implications of this issue be brought to public attention.

Lead contamination has been recently identified across the city, and specifically in the kindergarten funded by the Duang Prateep Foundation in Klong Toey. The Foundation has worked with slum communities in Bangkok to help local people and families and to promote community sustainability. As the sponsor of this study, the Duang Prateep Foundation is extremely concerned about the health risks posed to the children by this immediate lead exposure. In collaboration with our interdisciplinary team from Worcester Polytechnic Institute and Chulalongkorn University, the Foundation has begun an effort to bring public awareness to the lead paint problem in Bangkok communities.

In order to effectively prevent the onset of the detrimental health problems threatening Thai children and adults exposed to lead paint, our team identified and assessed the best practices and policies for lead contamination remediation and lead poisoning prevention, and subsequently analyzed our findings in terms of their applicability in vulnerable Bangkok communities. Furthermore, we evaluated current Thai legislative policies in order to identify potential areas of improvement for lead paint manufacturing and removal regulations. Based on this assessment, we made recommendations to design an educational campaign to raise awareness about proper lead remediation practices and lead poisoning prevention that fits with the Duang Prateep Foundation's mission. We gave materials to the Duang Prateep Foundation to head a national call to action concerning the issues of lead contamination and poisoning. By acting to empower vulnerable communities within Bangkok and building awareness at both a social and policy level, the Foundation can work towards eliminating lead contamination and its resulting health risks in Thailand.

Chapter 2: Literature Review

The following chapter examines information pertinent to the lead contamination issues in Bangkok, with the goal of identifying the factors important to understand, mitigate, and prevent this contamination and its subsequent health consequences in the future. A complete review of this information is necessary in order to define the context of this project, as well as to determine how to best fulfill the project objectives and goals.

We first looked into the basis for the recent and rapid economic shifts within Thailand, specifically Bangkok and the surrounding districts, from agriculture to industry. The slum community of Klong Toey is an example of a community currently impacted by this transition; we identified the factors that contribute to its vulnerability to lead contamination, and list the multiple risks this contamination presents to the residents. To understand these risks, basic information is presented regarding lead as a hazardous material, including the characteristics of lead as an element, its presence in nature, its role in industrial processes and more specifically its prevalence in the paint industry. The team studied the presence of lead in the environment, along with the regulations established in developed versus developing nations to manage this environmental contamination. We next examined the health effects of lead, particularly relating to its effects on the physical and mental development of children. We investigated the laws and regulations established on an international level in reduce lead concentration in the environment. Finally, we examined the two main approaches detailed for lead poisoning prevention. We assessed this issue specifically in the context of contamination of the Duang Prateep Foundation nursery school, analyzing how these factors contributed to the current situation.

2.1 Thailand: Industrial Development and the Emergence of Lead

The country of Thailand is a developing nation that has been undergoing substantial economic and industrial development since the 1960's. In recent decades, business in Thailand has branched away from simple processing industries such as rubber, lumber, and sugar, and transitioned into a technology-based market (Hussey, 1993). However, through a combination of economic, governmental and societal prompts in the mid-1980s, the manufacturing sector has propelled the Thai economy to be labeled the "Fifth Asian Tiger", joining Hong Kong, Singapore, South Korea and Taiwan as one of most developed Asian economies with world-leading technology centers and information technology systems (Hussey, 1993).

Infrastructure development has increased specifically in and around the capital city of Bangkok. The city is a prime area for industrial development due to simple and efficient transportation access to vital ports, highways and airports (Hussey, 1993) Bangkok has thus emerged as the premier manufacturing hub of Thailand. Additionally, westernization in Thailand has created jobs for Thai citizens, producing much profit for companies and manufactures based in developed countries in the world.

Rapid and intensive industrialization often leads to an increase emission of harmful and hazardous pollutants into society with numerous health consequences. In particular, multiple negative effects result from pollutants, chemicals and other hazardous or harmful toxins leaching into the environment. Due to recent and rapid industrialization, Thailand is facing challenges enforcing governmental regulations to control aspects of industry that are potentially harmful to the environment, allowing for several toxic substances to leach into the surroundings. Lead is one of the most prominent of these substances, and its addition into the environment has created a widespread occurrence of lead contamination.

Because lead and other toxic substances are prevalent in many aspects of modern society, it is critical to educate citizens about hazardous industrial pollutants and their health implications. For instance, lead is a toxin that is most commonly used in paints, batteries, cable covers, fishing sinkers, and solder for electronic components. In the past, the once rural and agricultural based society of Thailand did not face substantial health threats from lead. However, the convenient inexpensive use of lead in industries and

cheap products has allowed the element to become a direct health hazard to many inhabitants of poor communities, such as the Klong Toey district of Bangkok.

2.2 Site Specific Background: Klong Toey as a Vulnerable Community

The Klong Toey district contains the largest slum community in Bangkok, with just over 80,000 residents (See Figure 1) (Duang Prateep Foundation, 2006). Both the social and economic status of Klong Toey distinguishes it as a vulnerable community; several defining characteristics of the slum make its residents more susceptible to the dangers of lead poisoning. As one of the poorest areas in Thailand, Klong Toey lies in the shadows of the tall skyscrapers and businesses of downtown Bangkok. Its residents are typically the service workers that support Bangkok. Inundated by poverty, crime, and disease, Klong Toey rarely receives assistance from the government or the surrounding, more financially stable communities (Hopkins, 2005). Furthermore, due to a lack of strict regulations on industries in Bangkok, lead-based materials are often transported into the slum area unknowingly, contaminating the soil, water, and environment (Hopkins, 2005).

Figure 1:Location of Klong Toey District, Thailand

Most of the homes in Klong Toey have electricity and water, and many pathways are paved with concrete. However, many people are still living in extreme poverty, with family members crowding into small shacks (See Figure 2). There is limited access to health care; treating even simple conditions can be complex and costly. Because the houses were built unofficially there is an increased possibility for lead contamination in the home. Adding to the already negative situation, the slum is unrecognized by the government meaning that the residents can be evicted without warning, the children are not granted birth certificates and because of this the children cannot enroll in public school. The social conditions present in the community create an environment where many of the youth become involved with drugs and crime (Hopkins, 2005).

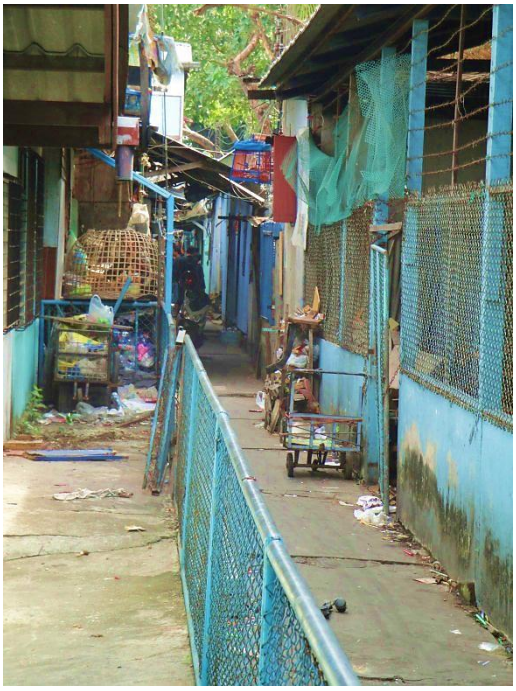

Figure 2: Houses along a narrow street in the Klong Toey community

The economic status of the residents of Klong Toey also creates living conditions that lead to the increased possibility of lead poisoning. Building codes are not necessarily followed in the construction of the residences. Families cannot afford reliable building materials, thus many homes are constructed with materials such as sheet metal roofs, rotting, wooden foundations, and dirt floors. The materials used to make the homes are

not up to any recognized code, and this poses a much higher possibility that they are contaminated with chemicals such as lead. Particularly, lead paint is readily available for comparatively low prices in Thailand (Hopkins, 2005).

The children of Klong Toey are particularly vulnerable to becoming ill from lead poisoning. In addition to the risk factors mentioned earlier, many children are not supervised during the day. The homes in Klong Toey are connected by complicated mazes of alleyways and garbage ridden streets. Children are exposed to drugs and alcohol at early ages. It is also a common occurrence for many serious crimes to go unsolved or unreported. This lack of supervision, in combination with the dirty environment and the generally bad hygiene habits of children, leads to a greatly increased risk of disease and exposure to toxins such as lead (Hopkins, 2005). Making matters worse, recent flooding in the region brought floodwaters one meter high into the slum, exposing painted surfaces to water and causing an increased incidence of flaking and peeling.

As a result of all of these factors, Klong Toey is significantly vulnerable to contamination and illness caused by lead. Consequently, because of the socio-economic limitations, the community has lost the power and ability to address these issues. One of the challenges that individuals assisting in relief efforts face is how to give this power back to the community so that it can take action to enhance quality of life in its neighborhoods. In Klong Toey, the Duang Prateep Foundation is a major contributor to strengthening resilience and encouraging empowerment within the community. The Duang Prateep Foundation was founded in 1978 by Prateep Ungsongtham Hata. The Foundation primarily serves the Klong Toey slum, promoting community development by providing economic, legal, and emotional support and assistance, as well as health care and education. Additionally, given the difficult living conditions in the community, the foundation operates to create a self-sustaining community (Duang Prateep Foundation, 2006).

Prateep Ungsongtham grew up in Klong Toey. She could only afford to spend four years in secondary school, and had to drop out to work on the docks at age twelve. She saved a small portion of her earnings until she had enough to pay for night school, and received a college degree in education. She used her degree to establish a school to serve the children of Klong Toey, hoping to give them the opportunity she did not have.

At first the small school was run out of her home, but she found that, rather than academic teaching, she was spending more time helping the children and their families deal with the conditions of the slum. She then decided to turn her school into the Duang Prateep Foundation, with the goal of instilling hope and belief in the future into her students. Today, Mrs. Prateep is recognized as a major liaison between the slum people and the government, trusted by both and constantly advocating for her neighbors. She has won the Magsaysay, Rockefeller, World's Children's Prize, and Global Friends awards. It is clear from firsthand experience and interactions with Mrs. Prateep, the great hard work and dedication that she has put into serving the residents of the Klong Toey Slum. With such efforts it is no surprise that Prateep has been nicknamed "The Slum Angel" by Klong Toey residents (Duang Prateep Foundation, 2006).

The Duang Prateep Foundation is unique because its leader grew up in Klong Toey and still resides there. Most of the staff resides in the slum as well. This stems from the Foundations philosophy that people who live in the community understand what the residents need. The staff believes in keeping a lot of good contact between Foundation and the members of the community, and welcome input and opinions from slum residents.

Today the Duang Prateep Foundation is a widely respected and established organization that has achieved international recognition. The foundation has also reached out to disadvantaged in rural Thai communities outside of Klong Toey and Bangkok (Duang Prateep Foundation, 2006). Locally, the foundation runs a multitude of permanent programs to provide for the residents of Klong Toey, including providing scholarships sponsoring education for more than 2,300 students, providing medical and emotional assistance for people with HIV and AIDS, establishing a credit union to teach residents responsible money practices, and running a traveling puppet show to provide the slum's children with educational entertainment. Furthermore, the Duang Prateep Foundation provides the children with basic needs that they may not find in their homes. One way they empower children is through nurseries or schools that the Foundation has built or funded. Schools provide a sense of stability and connection to the outside world, which these children may not receive in other areas of Klong Toey. In these schools, they

are sheltered from many of the harsh realities of Klong Toey and have a place where they can learn and play like children.

As a significant figure in the community, the Duang Prateep Foundation is a well-qualified organization to head an effective awareness campaign concerning lead contamination and the dangers of lead poisoning. The Foundation can play a significant role in such a project, acting as an instructor of and advocate for the proper hygiene necessary to prevent lead poisoning, as well as raise awareness about lead contamination issues across Thailand.

2.3 Industry of Lead-Based Paint

In order to best understand the severity of the hazard, we compiled recent literature about lead and its use in industrial settings. Lead is a bluish-grey heavy metal found in abundance in the Earth's crust; the use of lead by humans dates back to over one thousand years. Lead has several properties that are greatly favored by industrial manufacturers, who use lead as a raw material to many commonly used items (National Institute of Environmental Health Science, 2012). For example, lead is used frequently in paints to increase the color intensity and adherence.

There are two major types of paint used globally in the industrial and decorative sectors: oil-based and water-based. For individual projects, the type chosen depends on the application needs. As a comparison, oil-based paints are more opaque than water-based paints, therefore primer is not necessary to apply before painting the oil-based color. Oil-based paint can reduce the overall cost of a painting project because less paint volume needs to be purchased and there is less time associated with applying fewer coats of paint. Also in comparison to acrylic paints, oil-based paints are often preferred because the chemical composition allows the paint to more readily permeate the wall, giving oil-based paints notable durability (Oil Versus Latex Paint, 2012).

Though oil-based paints withstand wear and usage more readily than water-based paints, they also have multiple disadvantages, including lengthy drying time, poor color retention, and peeling and chalking over time (Oil Versus Latex Paint, 2012). To capitalize on the durability of oil-based paint, manufacturers use lead to counteract these drawbacks. Lead provides qualities desired by the consumer market, such as durability against corrosion, better color retention and high sheen (Kumar, 2009). Because adding

lead reduces drying time, lead additives are especially attractive for painters to use for exterior and interior painting. In addition, paint color is enhanced by lead additives. Sampling of lead in various colors has indicated that warmer shades of paint, including whites, yellows, oranges and reds, on average have higher lead concentrations, even across market brand variation (UNEP, 2011). In the paint content study published by Toxics Link in 2009, 63% of the tested paint samples containing high lead concentrations were shades of yellow and orange (Kumar, 2009).

Beyond the chemical benefits of using lead in paint, lead is inexpensive, making it ideal for paint companies to use it in their products (Yale-New Haven Teacher Institute, 2011). Though there are substitutes that act similarly to lead in paint, such as titanium dioxide (UNEP, 2011), lead is still widely used due to its availability. As demonstrated in Table 1, lead-based paint is commonly produced and used across the globe, and Thailand averages roughly in the mid-point of the listed developing nations in the concentration of lead in its household paints.

Table 1: Lead concentrations of new enamel household paints by country and percentages equal to or exceeding 90 and 600 ppm, dry weight (n=371)

(Clark, C.S., 2009)

Country	# of samples	Average	Geometric Mean	Median	% ≤ 90	% ≤ 600
Singapore	41	6,988	163	55	43.9	36.6
Peru	10	11,550	3,259	5,711	90.0	80.0
Indonesia	11	14,770	2,642	3,474	81.8	72.7
China	64	15,070	169	34	43.8	32.8
Nigeria	25	15,750	7,341	5,760	96.0	96.0
Thailand	**18**	**19,410**	**7,281**	**15,170**	**100.0**	**88.9**
Malaysia	72	24,510	769	614	59.7	50.0
Seychelles	28	24,880	1,167	2,527	67.9	60.7
Egypt	20	26,200	1,338	4,717	65.0	65.0
India	72	29,660	4,801	9,630	87.5	81.9
Ecuador	10	31,960	2,178	13,460	70.0	60.0

The paint industry in Thailand generated over 24,500 million Baht in 2007, with continued growth anticipated for future years. Though the majority of the approximately 300 paint factories are small, there are six major paint enterprises that control 85% of the market (Kumar, 2009). As stated in the correspondence with this research team, the Duang Prateep Foundation used the TOA paint brand in their nursery school. TOA Paint Thailand Co, Ltd represents 40% of the nation's paint commerce.

Through statistical measurements, Toxics Link has reported that of 27 paint samples from Thai national companies, the average lead concentration was 38,970.5 ppm, with 41% of enamel samples exceeding both the American regulations of 90 ppm and the Thai standards of 600 ppm (Kumar, 2009). Comparative studies of different types of TOA paints (ready-mixed and order-to-mix) have shown that TOA has capabilities to produce uncontaminated paint, but TOA paint with low lead content cost approximately three times more than TOA paints with higher lead contents (UNEP, 2011). This finding indicated that technologies are available to produce low lead level paints, but cost reduction is motivation to use lead. Total evaluation by UNEP found that paint with lower lead concentrations averaged 150 Baht per liter more than samples with higher levels of lead. This increases the probability that lead-based paint with concentrations over 600 ppm are be preferred in low-level markets over lead-free paints (UNEP, 2011).

2.4 Health Implications of Lead Contamination

Lead poisoning is a serious medical condition that results from the intake and build-up of lead-based materials over time. The United States Center for Disease Control defines lead poisoning as blood lead levels greater than 10 micrograms of lead per deciliter of blood. This is also the level at which the CDC recommends public health action be taken (Center for Disease Control, 2011). However, recent studies are indicating that levels of lead even lower than 10µg/dL can negatively influence both the physical and intellectual development of children (Koller et. al., 2005).

According to the US Environmental Protection Agency, the three most common sources of lead poisoning are lead-based paint, particularly paint that is deteriorating, lead contaminated dust, and lead contaminated residential soil. Lead poisoning develops mainly through the ingestion and inhalation of lead particles from these sources. Lead particles enter the blood stream and accumulate to higher concentrations with increased

exposure to the contaminated environment. Greater than 90% of the lead in the body accumulates in the bones. Lead in the bones can be released into the blood stream, and is carried throughout the body to other organ systems (Yale-New Heaven Teacher Institute, 2011).

In general, young children are at the highest risk for experiencing the extreme detrimental effects of lead poisoning. This higher potentiality is due to the difference in body mass ratio between children and adults; it takes a much smaller amount of lead for concentrations to reach toxic levels in children than it would in a larger adult (Department of Health, 2011). Additionally, children have increased susceptibility due to their hygiene practices. When children play with toys painted with lead paint or in soil contaminated with lead, and then put their hands in their mouths without washing them, they unintentionally ingest lead. The combination of hand-to-mouth activities and playing close to the ground increases their susceptibility to lead ingestion (CDC, 2011). However, adults can also experience severe symptoms resulting from lead poisoning.

The toxicity of lead is well-documented, though children and adults show different sets of symptoms. In children, the most sensitive target for lead poisoning is the nervous system. Exposure to lead can cause diverse neurologic or behavioral problems during their developmental years, such as inattentiveness, hyperactivity, and irritability. Other more severe problems include reading and learning difficulties, delayed growth, nerve damage and hearing loss (Eco-USA, 2011). In other organ systems, lead will interfere with the formation of red blood cells, kidney function, and synthesis of vitamin D. If not treated, these damages can be permanent (Yale-New Heaven Teacher Institute, 2011).

In adults, the most common symptom is high blood pressure, which may enhance strokes and heart attacks. High levels of lead in pregnant woman can be harmful to both the mother and fetus, causing an increased risk of complications during the pregnancy. These complications include shorter gestational period, irreversible brain or tissue damage to fetus, and miscarriage (Department of Health, 2011). A complete list of lead poisoning symptoms is provided in Table 2.

Table 2: Adverse Health Effects of Lead Exposure

(Department of Health, 2009)

Neurological Effects	Peripheral neuropathy
	Fatigue/Irritability
	Impaired concentration
	Hearing loss
	Wrist/Foot drop
	Seizures
	Encephalopathy
Gastrointestinal Effects	Nausea
	Dypepsia
	Constipation
	Colic
	Lead line on gingival tissue
Reproductive Effects	Miscarriages/Stillbirths
	Reduced sperm count/motility
	Abnormal sperm
Heme Synthesis	Anemia
	Erythrocyte protoporphyrin elevation
Renal Effects	Chronic nephropathy with proximal tubular damage
	Hypertension
Other	Arthralgia
	Myalgia

Due to the fact that the symptoms are general, lead poisoning can be difficult to diagnose. As an additional complication in diagnosis, patients often don't present with symptoms until the extent of the poisoning reaches a dangerous level. As a result, treatment for lead poisoning can be complicated. Medical treatment involves chelation therapy with *ethylenediaminetetraacetic acid* (EDTA). EDTA is a chemical compound that acts by binding to the lead, allowing it to exit the body through the urine (Mayo Clinic, 2010). Without the assistance of EDTA, lead is unable to exit the body, and simply accumulates in the various tissues. Although EDTA treatments are effective, lead poisoning often causes permanent damage that the treatment cannot reverse (Mayo Clinic, 2010).

Because of the irreversible long-term health effects of lead poisoning due to exposure, it is critical to take measures to prevent the incidence of poisoning. It is

important to educate both children and parents on the dangers of lead poisoning. Simple prevention methods include cleaning dusty surfaces and washing hands on a regular basis. In some instances, eliminating lead exposure is as simple as throwing away the contaminated toy or object However, the removal of lead is more complicated when the metals are thoroughly integrated in living environments (Mayo Clinic, 2010).

2.5 Remediation of Lead-Based Paint

If lead is detected within a household certain precautions are required to safely alleviate the contaminated site of the presence of lead. Lead exposure is especially detrimental to the health of pregnant women and children, as a result strict regulations have been put in place to remediate lead contamination (Lead Paint Removal, 2012). The inconsistent lead-based paint removal and containment methods in Bangkok have prompted numerous concerns regarding the public's health. A series of strict regulations have been compiled to effectively and properly remove lead-based paint in order to manage the non-biodegradable toxin. These detailed remove procedures are important because while lead paint presents a direct source of lead in the environment, it only acts as a poison when it becomes present in ingestible and inhalable forms. Any removal process of lead must be mindful of this factor in order to effectively eliminate the toxin from the environment. Lead has been introduced to the public environment through its presence in countless industrial processes and manufactured products. Petroleum and paint are some of the most common products that have emerged as a threat to the health of communities globally. While Thailand has successfully passed laws to remove lead from gasoline, lead-based paint is still readily available for purchase in the commercial industry. The abatement of lead-based paint must contain the health hazard at every step of the removal process in order to prevent its ingestion and inhalation by stakeholders.

Experiments have been conducted by environmental agencies to target the safest and most effective lead removal methods. Lead does not decay in the environment, and it also accumulates in the human body when ingested or inhaled; these factors subject the mitigation process to numerous precautions and regulations. The presence of lead-based paint in the wall surfaces of public and private buildings allows the paint to readily act as a vector for lead poisoning. While intact lead-based paint does not pose any health risks to individuals in the direct vicinity, lead-based paint that has deteriorated can pose severe

health risks, especially if it is further disturbed. Paint chips and small particles can become airborne and deposit themselves on surrounding furniture and other objects. Lead becomes a mobile hazard that is not contained to one area, creating numerous opportunities for ingestion and inhalation (Review of Studies Addressing Lead Abatement Effectiveness, 1998).

There are several processes used to remove lead paint. For individual cases, the method utilized is selected according to the site assessment. Some common methods of lead paint removal are known as vacuum blast (dry) cleaning, wet abrasive blast cleaning, chemical stripping, low heat processes, and wet scraping and sanding. Each process will further be explained in order to understand the general preference of lead removal contractors for each method (Administration, 1999).

"Vacuum blast cleaning" is a dry method. It consists of a nozzle containing an abrasive, generally made of steel or sand, which is propelled to the site of cleanup by compressed air. The nozzle is large enough to sweep up all debris before it dissipates from the wall and into the air. It therefore reduces the amount of lead dust in the air, and hence decreases the amount of airborne lead in the direct vicinity of the workers. Thus due to the strong suction abilities of the nozzle containment of the construction site is no longer as strict (Administration, 1999).

In contrast, "wet abrasive blast cleaning" is a process that requires more attention to the initial containment stage of the process. This is because the machine specific to this process releases a water waste that contains chips of the lead-based paint. The water must not be allowed to enter the local water drainage. The water is hence managed by securely containing the construction premises, including placing sand bags around the edges of the work zone to act as filters to the water that may bypass flimsy containment (Peel Away Australia-Asia Pacific, 2010). Other times the water is collected via a machine that both absorbs the water and filters it of the lead contaminant.

Chemical Stripping is another method used to remove paints however it adds additional health hazards to the work area and requires additional precautions to protect against toxic poisoning of the methyl chloride ingredients. Some chemical strippers also contain methyl chloride that is toxic to human health. If chemical strippers are applied on wood surfaces then an acetic acid solvent must be applied to the surface. Chemical

stripping releases a great deal of sticky paint residue and fumes that must be properly managed and disposed of.

Low temperature heat processes to remove thick layers of paint are required. Heat guns that exceed 1,100 degrees Fahrenheit are not allowed because they require the site to be ventilated and hence undermine the containment of the construction site. In addition when working on small jobs wet sanding and scraping are advised. These methods have the potential of spreading lead particles into the environment. Therefore, misting the paint surface with water helps to contain the generated paint dust and the placement of a plastic bag below the work site to prevent dispersal of the contaminated paint.

If abatement of lead-based paint is not feasible then interim maintenance choices are also viable. Well maintained lead-based paint poses negligible health risks to surrounding community members in comparison to deteriorated paint chips. Maintenance of the paint requires that the paint first be washed with a tri-sodium phosphate wash. The flaking paint chips are properly collected and disposed of to allow for the application of an encapsulating sealer to contain the paint.

2.6 International Laws and Regulations Restricting Lead Exposure

Many manufacturers will commonly choose to include lead in the production of paint because it improves the paint's adhesive character. The health concerns raised from the lead toxin has subjected many governments to place strict restrictions on the uses of the element however. While this is slowly becoming a nonexistent problem among developed first world countries, it is quickly becoming a pressing modern day issue for developing countries such as Thailand. It is therefore important to consider and analyze the credible regulations implemented among developed nations in order to assess the professional opinion about the most effective lead poisoning prevention and mitigation policies. This section assesses the various laws implemented worldwide to prevent lead exposure to contaminated lead-based paint and other sources.

In the United States laws concerning lead-based paint initiated in 1978 when lead-based paint was banned. In the years following that milestone, the U.S would continue to pass laws and regulations concerning the containment and abatement of lead sources, such as lead-based paint. The Environmental Protection Agency (EPA) has performed many experiments, studies, and reviews regarding the issue of lead contamination. In

1996 they released the final federal laws regarding the matter. Since then, many of the states began to adopt these guidelines as a means of lead abatement for buildings within their state grounds. In the U.S the remediation efforts initially targeted public facilities. However, as concerns about the exposure of developing children under six to lead sources grew, laws were reassessed to target private homes as well as schools, and daycare facilities. Since then many states have adopted these guidelines which aim to create a Model State Program to "safely, effectively, and reliably" abate lead paint. The final rule regarding the matter targets five main aspects of the abatement process. These include the "training, accreditation, certification" of workers dealing with the matter and the provision of "work practice standards and [their] enforcement" throughout the country. While in some states the issue is close to nonexistent, others still have millions of houses and buildings constructed prior to 1978 that must be inspected and remediated of their lead sources. Eliminating exposure to lead by banning leaded gasoline began in the 1970's in the United States; however, the process took twenty plus years to go through (Environmental Protection Agency, 1996).

France, Austria, and Belgium began to ban white lead-based paint in the 1920's, much earlier than the United States. From that point forward the many Western European countries also began to ban white lead-based paint especially as it was banned by the League of Nations in 1922 (Service, 2008). However, sources of lead exposure continued to affect people as lead was increasingly important to industrial processes and common in many products. The European Union did not ban leaded petrol from their countries until 2002 (Service, 2008). Therefore, while leaded paint was banned early on, the issue of lead contamination remained a problem for the European Union through other sources. However, the European Union did not have to invest their laws and studies as heavily as the U.S in removing lead-based paint from the walls of their infrastructure (Lead: The Facts, 2001).

Unlike the United States and the EU, lead poisoning remains a very crucial problem in the People's Republic of China. As one of the largest goods manufacturing and exporting country, lead contaminated products not only affect China itself, but also are distributed to consumers in other countries (Barboza, 2007). In dealing with this issue, the government in China had come up with several policies and regulations to

lower the amount of lead toxin usage in their consumer products. For instance, non-lead gasoline was introduced and promoted nationally in 2002 (Fairclough, 2007). Also, the first regulation on toy safety was implemented in 1986, stating that no more than 2500 ppm of lead should be found in coating in toys or stationary. This regulation was revised and later improved in 2003 to concentration of lead coating paint should not be more than 90 ppm in indoor declarative or any refurbishing materials (Lin, et al, 2009).

Despite government efforts to lower the usage of the lead toxin, the laws and regulations are merely a guideline for the industries to follow. Lead price is cheap and abundant therefore is favored by small manufacturer in China for consumer goods (Barboza, 2007). Some of these products are mass produced and exported to developed countries in Europe and the Americas and often rejected by such developed countries due to their high lead levels in paint coatings. There were also no follow-up regulations for existing houses or toys painted with lead-based paints. The message of lead as a potentially dangerous chemical in housing paints for children were not fully publicized by the Chinese government to their citizens, resulting in children with high lead blood levels throughout the country (Lin, et al, 2009). In summary, lead-based paint or materials still populate the market in China even though laws and regulations were passed by the government.

Australian regulations represent a unique case for controlling lead contamination. In Australia, there are two main federal Acts that guard the lead concentration in consumer products: Custom Act 1901 and Trade Practices Act 1974. Since 80% of consumers goods are imported from outside countries, both Acts control the amount of lead level in imported goods only (Povey & Roberts, 2010). Lead in paint was also a big issue in Australia. Australia did not set a maximal lead level standard but instead banned the addition of all 14 types of known lead compound into their paint (Bodel & Roberts, 2010).

Even though the Australian government kept strict regulations for banning lead usage, there are still limitations to these laws. The main limitation of the enacted laws in Australia is that they are only effective in terms of imported goods but not products produced and sold in Australia itself. For instance, it was recently found that Darrell Lea licorice, an Australian brand product, had high levels of lead beyond safety

recommendations for humans (Povey & Roberts, 2010). Other limitations in the Trade Practices Act is it neglects to include several possible lead coated products, especially children's toys such as sporting goods, public playground equipment, and costume jewelry. In consequence of not recognizing these products as children's toy, the health of children in Australia is still at great risk in terms of lead poisoning. While banning the use of all known lead compounds in paint and ink would appear effective, it would prove ineffective if the paint is made with other lead additives that are not included on the list of fourteen banned compounds. In summary, Australia shows great efforts in preventing lead products, but improvements can still be made to minimize the limitations of its own regulations (Bodel & Roberts, 2010).

As a final case, the minimal lead guidelines in Thailand are detailed below. Thailand's Department of Work Ministry has acknowledged lead as one of the many toxins in industrial processes posing health threats to exposed individuals. The Department of Work Ministry founded the Ministry of Industry in Thailand to establish regulations managing the emission and usage of these toxins with further aid from the Industrial Standards Institute (Thai Industrial Standard Institute, 2011). Limitations on the maximum level of lead allowed in all manufactured Thailand products were established to protect the consumers. Laws and regulation were also set in order to prevent industries from producing products or waste that contain exceedingly high levels of lead. The Thai Industrial Standards Institute introduced more than 2000 standards for all products ranging from foods, to electronic devices, to personal items such as clothes. For instance, standard number 272-2549 states that emulsion paint for general purposes must not contains lead more than 0.01% (100 ppm). Other examples such as standard number 1406-2540 and 1005-2548 state that flat enamel must not contains more than 0.06% (600ppm) of lead and semi-gloss enamel must not contains more than 0.01% (100 ppm) of lead respectively. However, these standards are set up as guidelines for the supplier to follow and are not implemented as legal limits (Thai Industrial Standard Institute, 2011). The sale and use of lead-based paint is still allowed in the country of Thailand. Thai ministries have not established a standardized procedure for lead-based paint abatement. For this reason different local construction companies and paint

contractors follow different policies and procedures that are often not mindful of the hazards of lead exposure.

Overall, these diverse sets of laws and regulations represent the initial steps for controlling and minimizing lead contamination and subsequently preventing lead poisoning. However, lead poisoning prevention requires multiple additional governmental oversight and regulatory precautions, particularly in areas where lead is already present in the environment.

2.7 Primary and Secondary Prevention of Lead Poisoning

There are two broad approaches that must be taken to prevent all types of environmental poisoning. One approach acts on a policy level where the majority of the campaign is performed by concerned legislators, while the other acts from within the community to empower citizens to take initiatives to prevent poisoning in themselves, their families, and their communities. In the United States Center for Disease Control and Prevention (CDC) description, lead preventative actions fall into either a primary (mainly legislative) or secondary (mainly community) prevention classification. Since Thailand has a significant number of people in the lower socio-economic classes, limitations arise as to the practical feasibility of some of the techniques described below.

In the case of lead, the CDC identifies two different sets of approaches that can be applied in order to prevent lead poisoning in individuals. These approaches complement the policy approaches described above. Primary prevention involves enacting legislature to monitor and control the levels of lead introduced into the environment and subsequently coming in contact with the community, thereby preventing the possibility of lead poisoning in the first place (CDC, 2004).

Secondary prevention involves mitigating contamination or poisoning that has already occurred, thus preventing the severe health consequences that subsequently result from lead poisoning. The CDC (2004) specifies that primary prevention, if possible, is the best practice for avoiding the health effects caused by lead poisoning:

> …primary prevention interventions to reduce lead exposures population-wide have succeeded. Primary prevention of lead hazards within the home of an individual or community level requires that lead-based paint hazards in and around homes be identified and controlled before a child is exposed (Retrieved from CDC, 2004)

However, if the contamination has already occurred, then preventative efforts should include both primary and secondary measures in combination. This is because secondary measures alone "have limited benefits for most children living in housing that poses an increased risk for lead-associated health effects", as the lead source is still present (CDC, 2004).

Overall, both primary and secondary measures must be taken to fully and completely mitigate lead contamination and its subsequent negative impacts. With primary prevention efforts leading to a long term solution, and secondary prevention efforts allowing for immediate action, lead can be successfully removed from the environment over time. In accordance with this idea, we assessed the applicability of both prevention methods within the context of the situation at the Duang Prateep Foundation nursery in Klong Toey.

2.8 Site Background: Duang Prateep Foundation Nursery

In 2007 the Child Safety Promotion and Injury Prevention Research Center conducted a lead testing project within the districts of Bangkok, including Klong Toey. Numerous samples were taken from multiple different buildings within and around the Klong Toey area. The center detected dangerously high levels of lead paint in the walls of a Klong Toey nursery run by the Duang Prateep Foundation. Within the nursery, the wall paint was the only source of lead contamination, with levels exceeding the acceptable health standards of 90 parts per million (ppm). In order to mitigate the problem, the Duang Prateep Foundation hired a private contractor to remove the paint in the building.

The nursery was retested in 2009 by the Provincial Coordinate Center for Civil Society Organization. Surprisingly, the lead level increased by a significant amount; the new concentration was found to be 2,582 ppm. Due in part to these findings, *The Daily News* published an article on February 11, 2010 that discussed the general health risks of lead contamination posed to the students of these nurseries. In addition to the Duang Prateep Foundation, nine other nurseries were mentioned in the same article, demonstrating the larger scope of the problem.

This unexpected increase in lead levels has caused the Duang Prateep Foundation to review previous steps taken to remove the lead-based paint from the nursery. Prompt

remediation is critical because lead poisoning poses both physical and mental health risks to both the teachers and the children who attend the school. Our team assisted the Foundation by proposing preventative means to alleviate lead contamination from lead-based paint both in the nursery and throughout Bangkok.

This background chapter aimed to understand the nature of lead and its industrial uses, as well as the health implications the prevalence of lead in modern society has created. Additionally, the chapter reviews laws in the developed and developing world, including Thailand, to determine where there is need for governmental action. In understanding the complexities underlying lead and its many forms, we researched the most credible methods to support recommendations toward mitigating the clear problem of lead contamination in Klong Toey and Bangkok.

Chapter 3: Methodology

Our team identified the best practices for lead poisoning prevention by assessing policies for lead contamination remediation and subsequently recommended an educational campaign to raise awareness about these methods in vulnerable Bangkok communities. In completing this project, our team worked with the Duang Prateep Foundation to provide the tools necessary to apply successful lead removal procedures and lead poisoning prevention methods both within their sponsored school and other schools beyond the Klong Toey community.

We identified four objectives to complete to accomplish the above goals:

1. Perform a comparative analysis of the best practices for lead contamination remediation from a global perspective
2. Perform a comparative analysis of the best practices for preventing and minimizing health risks of lead poisoning from a global perspective
3. Assess current local attitudes and practices pertaining to lead contamination in Bangkok
4. Evaluate successful educational public awareness campaigns and identify effective methods for designing an educational campaign

For our overall analysis, we utilized the problems facing the Duang Prateep Foundation at their Klong Toey Nursery as an *instrumental case study*, allowing their story to provide insight into the larger context of the issue (Berg, 1998). By examining the nursery as a case study within a more widespread problem, we not only assisted the Foundation in mitigating their individual situation, but we also provided the Foundation with material and information with which they can lead a national campaign to help other organizations throughout Thailand experiencing lead problems. The strategies applied to accomplish each project objective are detailed below.

3.1 Comparison of Lead Remediation Methods

The purpose of objective one was to perform a comparative analysis of the best practices for lead contamination remediation.

To accomplish objective one, we completed research on multiple global practices and policies established for lead contamination remediation. This research was conducted

to understand the variation in lead-based paint removal practices internationally, as well as to identify the *best practices* for remediation. It is understood that the *best practices* are the implemented regulations that are the most stringent about protecting human health and the environment (Bardach, 2009). Case studies of various nations were examined to assess the differences in remediation methods and lead-based paint removal regulations. International cases were carefully chosen and studied to provide a comprehensive picture of similar contamination situations dealt with by different processes. We specifically completed research specific to Thai policies on lead decontamination and then supplemented that information with research directed at the practices of lead-based paint removal in Thailand.

3.2 Comparison of Preventative Health Practices

The purpose of objective two was to perform a comparative analysis of the established best practices for protecting individuals from the health risks of lead poisoning.

To accomplish objective two we completed extensive research on lead poisoning preventative practices. As in objective one, the best practices for the prevention of lead poisoning were identified and subsequently analyzed in terms of their applicability to Thailand.

This compiled research was supplemented with information gathered from an interview with a well-established physician at Child Safety Promotion and Injury Prevention Research Center Bangkok's Ramathibodi Hospital, Dr. Channarong Wayapoj, who heads a study concerning multiple aspects of lead poisoning and prevention (see Appendix A-2 for details). The interview was conducted in a *semistandardized* format, which allowed for our group to gain the answers to specific questions, as well as to learn pertinent information not specifically detailed in the question set (Berg, 1998).

3.3 Assessment of Local Attitudes and Practices

The purpose of objective three was to evaluate and assess the current local attitudes and practices pertaining to lead contamination in Bangkok.

To accomplish objective three, we conducted a series of observations, interviews and surveys of various sources in the Bangkok area.

Attention was first focused on professional contractors in the Bangkok area. Interviews were performed to objectively evaluate the lead-based paint removal practices used by average contractors in Bangkok. Due to the time constraints of this project, five contractors were selected using a *sample of convenience* (Berg, 1998). These contractors, to remain anonymous throughout the report, were interviewed with a *semistandardized* format to document the various methods of lead-based paint removal used, as well as to assess the contractor's knowledge and concern regarding the methods of contracting and health risks of lead exposure. The set of questions used when conducting these interviews is detailed in Appendix A-1.

In addition to these contractor interviews, effective and safe remediation procedures practiced within Thailand were investigated through a *semistandardized* interview with the coordinator of the Lead Fighting Team, an organization mindful of the health impacts of lead. The organization was also selected because it has had documented success with lead contamination remediation in Bangkok communities. The interview was conducted based on a similar set of questions used for the contractor sample, and supplemented with additional questions detailed in Appendix A-3.

As a final method to complete objective 3, the local perceptions of lead as a dangerous toxin were evaluated through *evaluation surveys* given to the general public (Salant, 1994). The sample selected included 80 Bangkok residents from varying demographics to ensure a range of knowledge levels. This larger number was selected to ensure that multiple types of people were included in the sample. The sample was *purposive* in order to ensure it included community members of interest, such as parents of children under the age of 6 and teachers (Berg, 1998). Survey questions and design are detailed in Appendix A-4.

3.4 Evaluation of Educational Methods

The purpose of objective four was to evaluate successful educational public awareness campaigns and identify effective methods for designing an educational campaign.

To accomplish objective four, we performed analytical research, to fully evaluate public awareness campaigns, as well as performed observations, surveys, and interviews to define the applicability to the Duang Prateep Foundation's nursery in Klong Toey.

This research, on successful and unsuccessful educational campaigns, was conducted on a global scale to highlight the role of different cultures on the methods used. A comparison of the results was conducted in order to establish the most appropriate methods of education for urban Bangkok communities.

Once the research of campaigns was completed, an *evaluation survey* was administered to the teaching staff at the Duang Prateep Foundation to assess the knowledge of lead contamination and lead poisoning within the school faculty (Salant, 1994). Survey questions can be found in Appendix A-5.

Finally, we conducted a series of interviews in Thai, which provided information that allowed us to understand the educational techniques and methods specifically employed by the school. The principal of the school, who designs the lesson plans, was also interviewed to obtain more specific information pertaining to how an effective educational campaign may be incorporated into the nursery. Interview questions can be found in Appendix A-6. Additionally, we conducted personal observations of the interactions between the students and teachers at the Duang Prateep Foundation nursery during a typical school day. These observations allowed us to see first-hand how the students behave, what types of activities interest them most, and what their daily schedule is.

3.5 Context Limitations

Considering all of the information and perspectives encountered in our research, we faced several challenges in completing all of our objectives. The incident of lead contamination at the Duang Prateep Foundation nursery is one case out of many other similar situations in Thailand. Instead of focusing on only the Foundation's individual situation, we took into consideration different factors that could arise in multiple locations in Bangkok while designing an "awareness campaign". One of the problems we encountered was the range of cultural differences between our project team, specifically the American students, and the members of local communities.

The language barrier was clearly the most difficult challenge presented by the methodology, as it created the potential for misinterpretation during surveys and interviews. Fortunately we were an international team that included three Thai members. Because a large portion of data collection was based on personal interactions, clear and

accurate communication was critical. To overcome the difference in languages, two of our Chulalongkorn University group members acted as translators for the team and translated all discussions conducted in Thai. By talking to the parents of the community we learned that the literacy rate of the adults in the Klong Toey community is low, adding another complication in communication. Because the full subject base would not have understood a printed survey, the project team had to focus the data collection methodology on processes that did not involve substantial text components.

In addition to these communication barriers, we also considered equally important cultural challenges when devising our interview questions, surveys and meetings. There are distinct differences between acceptable communication styles and mannerisms of Western and Thai societies; Western culture has a tendency to be direct in conversation, while in Eastern culture people are more conservative when communicating. To sensitively consider this challenge, our questions were carefully structured and worded to avoid offending the people we were working with. At the same time, many of the subjects involved had different motives arising from their own personal interests. We devised a set of generalized questions worded to avoid biased data and potential cultural miscommunication. All such considerations formed a carefully articulated methodology that provided a clear and objective representation of the situation at hand found in Appendices A-1 through A-6.

The final contextual limitation we identified is the individual nature of each case of lead poisoning. Because each incident of lead detection and subsequent lead poisoning is unique and dependent on multiple different factors, it is difficult to accurately compare other cases of lead contamination with the situation at the Duang Prateep Foundation. Additionally, lead will affect individual people differently based on their weight and height. No one case study could be examined and related directly to our project without considering the multiple factors that led to each case of lead contamination or lead poisoning.

Overall, our project focuses on culturally, emotionally, and technically complex issues. Our methodological design was therefore based on the proper formation and maintenance of personal relationships, particularly relating to understanding the perspectives of all of the stakeholders. Carefully considering our objectives, we

conducted data collection striving always for sensitivity and concern towards those impacted by the events.

Chapter 4: Findings and Analysis

We presented in the following chapter results of our research and data collection. The relevant findings on the best practices of lead-based paint removal (see Literature Review) were compared to the current practices followed by contractors in the Bangkok area. Community outreach and educational methods on health campaigns that we identified and evaluated based on their applicability to lead contamination concern at the Duang Prateep Foundation nursery. We discussed and analyzed below interview responses considering the behaviors and knowledge of community members in Klong Toey and members of the Duang Prateep Foundation nursery concerning lead contamination. We also presented the evaluation of educational methods towards the target audiences (contractors, general community, and parents and teachers) are also presented for analysis.

4.1 Best Abatement Practices for Lead-based Paint

The best practices for remediation must be established in order to effectively abate lead-based paint to permanently remediate lead contamination throughout Thailand. By providing contractors with these lead-safe practices the community at large would be protected from the health hazards of lead exposure.

4.1.1 United States lead-based paint abatement practices

The United States federal government began to restrict lead-based paint in 1978 and since then the Environmental Protection Agency (EPA) has adopted the best practices to effectively abate the paint from the homes of residents (Bodel, 2010). The goal of the removal process is to both manage the dust and debris generated by the construction processes and to keep non-authorized personnel outside of construction sites therefore ensuring that individuals are not exposed to lead in the process. The EPA lays out the proper removal methods via a seven step program known as the *Renovation, Repair, and Painting Rule* or the RRP rule. The RRP rule is a set of guidelines that are implemented during any process which disturbs lead-based paint in contaminated homes and child-occupied facilities. Contractors involved in such processes can become certified by going through a program officiated by the EPA. The EPA first requires these certified personnel to provide the residents and occupants of the facilities with

the *Renovate Right* pamphlet. This pamphlet informs individuals affected by lead-based paint disturbances in their homes about the precautions that must be understood in order to protect them from the contaminated work site. The contractors are then required to take numerous containment precautions themselves in order to protect the workers and surrounding residents (HUD, 2011).

4.1.2 Containment

When removing lead-based paint, multiple precautions are undertaken to protect the safety of the workers, the surrounding site occupants and the environment. The first measure is for the workers to wear protective gear to protect their entire body from the harmful debris. The most important gear is the facial mask because it protects against ingestion and inhalation of the toxin. The entire site must be contained in plastic coverings that are firmly situated around the construction site and the debris matter enclosed in thick plastic bags (Lead Paint Safety a Field Guide for Painting, Home Maintenance, and Renovation Work, 2001). All objects within the construction site are contained and covered with plastic to shield from construction debris. It is equally important for construction workers to contain their protective gear in plastic bags upon removal (Lead Paint Removal, 2011). Collectively, containment precautions eliminate the risk of contamination spreading to other sites. Appendix B-1 describes the step-by-step containment process as dictated by the EPA. Furthermore, regulations regarding renovation, repair or painting methods are set in place to manage and reduce the amount of contaminated debris generated by the process.

4.1.3 Viable Removal Options

There are several removal methods that effectively and safely remediate lead contamination due to lead-based paint. However, some methods are more practical than others. In the United States the most prominent method of lead-based paint removal is the use of a sanding machine with a HEPA vacuum attached at its nozzle. The EPA, recognizing the superiority of the HEPA vacuum method, supplies certified contractors with the proper instruments. This vacuum filters the air of dust and debris that contain lead particles. This method is efficient, though drawbacks include that the worker has to be qualified and that the machine is mainly effective on flat surfaces. The effectiveness of

removal methods is dependent on the amount of contaminated debris and how easily it becomes uncontained. A case study (see Appendix B-2) was performed in New Zealand that proved the efficacy of various lead-safe removal methods in abating lead-based paint with the exception of heat guns. Heat guns that reach temperatures over 1,100 degrees Fahrenheit pose the risk of lead poisoning through toxic fumes if the area is not well ventilated.

4.1.4 Relevance of Best Practices to Thailand

There are a number of states in America undertaking efforts today to remove lead-based paint from public facilities and homes built prior to 1978. Considering the preferred method of using a dry sander with a HEPA filter, the combination of certified personnel and refined equipment reduces the risk of releasing dust and debris into the surroundings. While such lead abatement policies and practices demonstrate the best containment and removal methods, the efforts are not generally feasible in Bangkok.

Today, Thailand's legislation concerning lead exposure is limited to policies restricting lead sources from industrial processes. Legislation does not yet consist of policies banning the use of lead-based paint and regulating effective removal of lead-based paint. In Thailand it is not realistic to provide all local contractors with the expensive dry vacuum and HEPA filters as in the United States. Therefore it was important to assess the efforts underway in countries where lead-based paint abatement practices are still developing, and not as established as the laws found in the U.S.

This research led to the assessment of current efforts in Australia, revealing that lead-safe removal methods employed nationally more closely represent the current conditions in Thailand.

4.1.5 Australian Lead-based Paint Maintenance and Abatement Practices

In Australia, lead was significantly present in almost fifty percent of paints manufactured before 1950. In 1970, the manufacturers were required to reduce the amount of lead in paints to less than one percent, a concentration still hazardous to human health. It was not until December of 1997 that Australia restricted the allowable lead content of paints to be lower than 0.1% (Australian Government Department of the Environment, Water, Heritage, and the Arts, 2009). In Australia, all homes built prior to

1997 are advised to be tested for lead-based paint. As a result of the comparatively recent development of legislation in Australia, the situation closely resembles that in Thailand where lead-based paint has not yet been banned and all facilities are beginning to be tested for lead-based paint.

Lead-based paint is more prevalent in Australia than it is in the U.S., and as a result the main divergence between the government recommended practices lies in the degree of legal control. Unlike the strict full lead removal policies found in the United States, Australia's official manual provides several interim maintenance options along with various abatement procedures. The manual begins by acknowledging the higher health risks posed to individuals when exposed to the haphazard disturbance of lead-based paint in comparison to the simple maintenance of the lead-contaminated paint. By maintaining the paint the residents have one of two interim options that should be temporary until full removal is an option. Building owners may either leave the paint if the paint is not deteriorating or they may choose to paint over the lead-based paint via an encapsulation process. The case study conducted in the United States (see Appendix B-2) proves the efficacy of interim methods and their ability to lower children's blood-lead levels before permanent lead-based paint abatement procedures take place. By applying interim methods, to only temporarily protect the inhabitants, inhabitants' blood lead levels were reduced. The Australian manual also provides the renovators with numerous removal methods and the advantages and disadvantages of each method, as is detailed in Appendix B-3.

4.2 Current Lead Remediation Practices and Attitudes in Thailand

The current status of lead paint remediation knowledge in the Bangkok renovation industry was assessed. Each contractor interviewed recognized the differences between acrylic and oil-based paint removal. Comparison of oil-based paint removal methods of the contractors showed that most contractors had similar removal processes with only small differences. Additionally, most of the contractors acknowledged the risk of working with lead-based paint, but continue to follow practices unsafe for their personal health, the health of building occupants and the health of the environment.

Besides the contractor's awareness, the practiced method of paint removal was evaluated. Typically, removal processes, completed by Thai contractors, for oil-based

paint do not take into consideration further lead contamination through the removal process. A comparison of proper oil-based paint removal methods versus lead-based paint removal processes revealed a more stringent and thorough process for toxic decontamination. Notably, safe lead-based paint remediation should take two to three months, much longer than simply removing paint.

In Thailand most contractors develop their work methods through personal experience, and this includes paint removal. There are lead-based paint removal courses set up by large paint manufacturers, but not many Thai contractors are certified. To demonstrate this, some of the interviewed contractors knew of these information classes though none of them had gone through the training program. Reasons cited for not attending such programs included lack of time, interest and cost. Because of the contractor's budget, he is also limited on product choice. Non-toxic removal solvents and lead-free paints are more expensive, and therefore not usually feasible for the project allowance. It was estimated the average price for lead-safe paint is 30% higher than lead-based paint. In addition to buying low cost products, the contractors we interviewed did not own or use adequate personal protective equipment. Though the Lead Fighting Team suggested full PPE, including goggles, ventilator mask, gloves and hazardous materials suit, many contractors simply wore a paper face mask as described by an interviewed contractor: "Our workers understand there is [personal protective] gear, but I do not bother with that. I use a face mask and my normal work clothes. It is easier." The lack of emphasis on occupational safety poses extreme health hazards to contractors who are directly exposed to lead-contaminated dust.

4.3 Community Outreach and Education

Complete poisoning prevention requires two types of approaches, primary and secondary, described in section 2.8 *Primary and Secondary Prevention* in our review of literature. We assessed both of these overarching prevention methods, one aimed nationally and one locally, specifically in the context of lead remediation.

Primary lead remediation mainly involves lobbying for stricter standards and regulations, making paint manufacturers aware of lead alternatives, and encouraging consumers to be aware of the differences between lead-based paint and lead-free paint. While most of these practices focus around legislators lobbying for policy changes, there

are still techniques that can be performed more quickly at the community level to prevent initial contamination. For example, educating consumers on how to identify the labels on paint cans provides a means of primary prevention.

Paint labels, produced by the manufacturer, display specific symbols indicating lead-based verses lead-free paints, shown below in Figure 3. If community members are made aware of these symbols, and know what to look for when purchasing paint for their homes or businesses, it will enable them to make sounder decisions and avoid future use of lead-based paint.

Figure 3: Thai paint container with lead-free symbol

Secondary remediation requires a community-based approach, as concerned citizens can be empowered to take action into their own hands. The CDC guidelines, specifically relating to lead, specify several key secondary preventative actions critical to future prevention, including:

- Eliminating the source of the contamination.
- Incorporating blood screening for all at risk family members, particularly the children. This screening should occur on a regular basis from a very young age, whether or not symptoms are evident.

- Incorporating lead hazard screening, dust testing, and surveillance of contaminated buildings as recurring processes.
- Raising awareness about knowledge including recognition of the need to contain lead dust during clean-up and recognition of hygienic practices such as hand washing.
- Providing basic training for contractors on lead-safe work operations and practices.

Additionally, there are several measures for lead poisoning prevention that fall into both the primary and secondary prevention categories. Examples are as follows:

- *Analyzing and publicizing data*

The community can work with local officials or community leaders to complete a small area analysis within their neighborhood to uncover the extent of the problem. This approach demonstrates that the contamination problem can affect anyone, even the homes and offices of the upper classes and governmental officials.

- *Creating a demonstration home or wall*

Making an example of one home or isolated wall to show the pervasiveness of lead contamination problems, as well as how lead paint hazards develop, delivers a lasting visual impact on both concerned legislators and community members (CDC, 2004).

- *Integrating lead poisoning prevention into medical education curricula*

Prevention methods can be further amplified by community members when working closely with their local physician. If the doctors who serve the local community are identified, patients can make a point to ask for screening on lead contamination, or encourage the doctor to become more aware of the issue.

In applying both primary and secondary prevention methods, a best practice associated with any prevention effort "community-based collaboration".

> …Collaboration is defined as sharing of power, resources, and authority; community-based collaboration refers specifically to collaborative efforts that are anchored in partnerships among individuals and groups within the community and, as such, bring together those stakeholders who affect and are affected by the issue at hand (Retrieved from Bond, 2007).

Having this overarching theme of community-based collaboration facilitates the six characteristics essential for an effective prevention campaign, defined and described as follows in Table 3 below (Bond, 2007).

Table 3: Necessary factors for effective prevention of lead poisoning

(Modified from Bond, 2007)

Prevention Efforts are:	**Description**	**Benefit**
Based on sound theory and research	Examines both the theory and applied science behind the issue	Creates an understanding of the problem from multiple different angles
Based on a comprehensive, multilevel perspective	Identifies the perspectives of the many levels and groups within the community	Allows for all members of the community to be involved and reached
Built upon community strengths	Focus is placed on the strengths of the target community	Creates a stronger campaign if present strengths are employed and further developed
Sensitive to the specific population and context	Generalized methods are adapted to fit the specific characteristics of the community in which they are being implemented	Increases the overall effectiveness and sustainability of the prevention methods
Continually evaluated	Reassesses the efforts on a regular basis	Allows for needed adjustments and changes to be identified and implemented
Sustainable	Creates an ongoing effort	Produces a lasting effect for a permanent solution

To supplement general research on policy, we identified three case studies from different countries in order to evaluate the best prevention of toxic poisoning practices. In India, there is a lack of safety precautions on the part of uneducated workers, a lack of controlled standards for toxic chemicals in industry, only rare health checks for

employees working in dangerous situation, finally many products with toxic chemicals in them are insufficiently labeled. Similar situations have occurred in Chile and the United States. The governments of these three nations have each employed practices to prevent and manage the effects of toxic exposure. However, within these three situations, the approach has been largely different based on the characteristics and features of the target audience. These factors including literacy rate, access to media, education level, and cultural practices must all be taken into consideration and evaluated in terms of their applicability to the given target audience in each situation. The specifics of these case studies were analyzed in relation to their applicability in Klong Toey in the analysis section of this chapter.

4.4 Addressing Public Policy

Towards the end of our project, in collaboration with our sponsor our group was able to obtain a meeting with the Director of the Social Development Department at the Bangkok Metropolitan Administration. Although we initially considered this prospect as a goal for future efforts, both our group and our sponsor recognized the urgency of the issue. We therefore decided to attempt to bring it to the attention of the government in order to begin the process of encouraging the development of stricter public policy regarding lead. Based on the influence and passion of our sponsor, the BMA agreed to hear a presentation from our group regarding the prevalence and dangers of lead throughout Bangkok. At the conclusion of the meeting, the social sector director of the BMA communicated his sincere gratitude for our presentation and stated that he would thoroughly review our report and work to try and begin immediate implementation of educational campaigns regarding lead poisoning in Bangkok. He also informed us that he would begin looking into public policy development for removing lead from paint. A detailed explanation of the outcomes of this meeting can be found in Appendix B-11.

4.5 Local Knowledge and Behaviors Regarding Lead

Our team conducted a survey of the general public in three different areas of Bangkok: Klong Toey, Chamchuri Square, and the Chulalongkorn campus, (see Figure 4).

Figure 4; Participants filling out our survey to the general public

The responses that were collected indicated that in general there is little known about lead throughout the populace. In fact, 29 out of the 80 people surveyed did not even know lead had negative health consequences. Even fewer knew that lead came from paint. Most people surveyed knew that lead could be found in certain other sources such as gasoline and the paint used in toys. However, another common answer we received indicated that the people believe the government is not doing enough to rectify the issue of lead in Thailand. Also, respondents stated they would be willing to learn more about lead contamination and poisoning as it relates to paint. Generally, there is very little known about lead throughout the communities that we surveyed. For details on the survey see Appendix B-6.

Additionally, our team observed the children in the nursery in order to understand the hygiene they practice on a daily basis. Starting from their arrival at school in the morning, the children immediately begin proper hygiene practices. They never take their dirty shoes with them into the classroom and they wash their hands and mouths at every convenient opportunity. In order to teach them these life skills and other academic subjects, the teachers utilize a technique known as the Montessori Method. Following this method, children utilize the various academic tools available to them while the teachers act more as supervisors. The personal and individual contact that the teachers have with the children is effective for young-age development (Rathunde, 2001). The older children

are apt to assist the younger students with the educational process, furthering the social development of the children. In our observations, we noticed that sometimes the children would not utilize the proper hand washing methods taught to them in the classroom, which is at their age not surprising. Overall, proper hygiene is taught and practiced in the nursery (see Figure 5), but because the children are learning independently (see Figure 6), they do not always actively practice what they are taught. For more detailed observations please refer to Appendix B-7.

Figure 5: A child self-learning at the Duang Prateep Foundation Nursery

Figure 6: Student learning good hygiene practices

After the observations, on January 25, 2012 we visited the nursery to conduct a survey among the teachers to determine what they understand about lead contamination and poisoning. After reading and analyzing the results, we found that the answers were highly varied in content. Our team gathered from question one that all of the teachers have worked at the Duang Prateep Foundation for a varied number of years (see appendix A-5 for survey questions). One teacher worked at the Foundation for seven months, while another teacher worked there for thirty years. It was found that all teachers knew in general that lead presented a health problem, indicated by question two. Question three, dealing with the effects of lead, produced the most varied answers. When asked if they knew what the effects of lead were before and after the discovery of lead contamination at the nursery, subject ten wrote that lead comes from utensils and toys, while

subject five wrote that lead comes from the walls. Almost all of the teachers noted that the children put their hands in their mouths (see Figure 7).

Figure 7: Nursery school student putting toys into his mouth

When asked about question five, most of the subjects understandably could not surmise the difference between lead contamination and lead poisoning. Most of the teachers did not attempt to differentiate between the two; instead they used only one sentence to describe the effects of lead. On question six, the subjects wrote down many different symptoms of lead poisoning, such as skin irritation and cancer. The only common answer that many of the subjects shared however was that they believed (correctly) that lead poisoning causes mental defects in children. Lastly, on question eight, many of the teachers showed interest in learning more about lead poisoning and lead contamination.

Finally, we conducted interviews with the principal, head teacher, and other teachers. During our interview with the teachers and the principal on January 31, 2012, there were a few important pieces of information we gathered. First, the parents and teachers have a good relationship with each other. The principal explained that the parents respect the teachers and due to growing concern over the issue of lead, would be willing to listen to the teacher's advice. The second piece of information we learned is that the best way to educate the parents and the public is through visual and interactive learning because many of the people in the Klong Toey district are illiterate. The principal also suggested using the intercom system found in Klong Toey because that is the way most of the people in the district receive the news on a daily basis. The

third fact we learned from the teachers confirmed what the survey of the teachers told us. While the hygiene practiced in the school is above satisfactory, the knowledge of lead is very low. All of the teachers seemed very interested in learning more about lead contamination and poisoning so they can help protect their students. To see the interview questions and answers please see Appendix B-9.

4.6 Analysis of Lead Remediation Practices

In both Thailand and India, management of toxins in the environment are undermined due to inadequate awareness and regulation of the health hazards. India is currently investing extensive time in identifying the leaders in vulnerable communities and assessing the best way to reach out to communities and persons at risk by providing services. Our findings indicated that the lack of awareness regarding lead poisoning in the daily lives of vulnerable stakeholders and officials was the most important issue of widespread lead contamination in Thailand. Therefore, we focused our lead poisoning prevention strategies around raising knowledge among key community members of the well-established and respected Duang Prateep Foundation. Via primary and secondary prevention efforts we aim to educate the Klong Toey community by authorizing the Foundation to disseminate prevention strategies.

Lead-based paint is not regulated in Thailand and hence it is widely prevalent within communities. The Thai government does not currently have legislation in place to mitigate lead-based paint; therefore governmental intervention is anticipated to be a tedious slow process. It will thus be most effective to provide effected communities with secondary prevention methods to prevent lead poisoning. By providing the Klong Toey residents with the knowledge and educational material needed to combat the prevalent lead contamination, the Duang Prateep Foundation will be better enabled to solicit governmental involvement in the long run. Our findings establish the best lead-safe removal practices and means to educate the community about proper protective measures against lead poisoning. The findings also assessed the level of lead awareness and the daily hygiene habits and practices surrounding lead-based paint in order to effectively implement lead-safe practices and habits.

Taking into consideration the low budget of most private homes and facilities in low income areas such as Klong Toey and the inadequate supply of contractors certified in removing lead-based paint, the findings we set out to determine the most practical and effective lead abatement practices for Thailand. First, the option of maintenance of the lead-based paint is

viable in areas that are not subject to chipping and flaking of paint. Maintenance of lead-based paint is strictly a temporary option in Thailand, because flooding is common and humid conditions are present year round that readily deteriorate the paint. To choose to maintain the lead-based paint in such circumstances would subject the paint to recurring maintenance and repainting, which is ineffective in the long run. The analysis of the self-guide manuals provided by Australia and the United States collectively recommend the safest and most effective practices necessary to remove lead-based paint in accordance with Thailand's available resources. Resources and survey information from Thai contractors allow us to determine what can be feasibly done in Bangkok.

Thai contractors revealed that renovators were neglectful of the presence of lead in construction sites due to monetary limitations and time constraints. Contractors did not examine construction sites for lead and lead-free symbols imprinted on paint cans are often ignored along with a number of precautionary measures. It is hence necessary to inform the public and contractors of these symbols as visual aids when purchasing paints and to potentially educate contractors about proper removal methods. Thailand needs to implement more legal regulations and standards that contractors must follow in order to protect them as well as home and building occupants.

The general public possesses limited knowledge about lead contamination, its sources, methods of poisoning, and related symptoms. Within the general public both teachers and parents demonstrated an overall lack of understanding about lead. This reality was of alarming concern because teachers and parents were the representative caregivers of vulnerable children within the community. Overall, the Foundation's Kindergarten teachers implemented hygiene and health practices that were exemplary. Still, high risk habits that subject the students to lead exposure due to lead-based paint must be addressed and prevented. Illiterate parents can be educated through auditory and visuals measures, while teachers can be taught poisoning prevention practices via lectures and handouts. By raising awareness among teachers and parents, we aim to establish effective interactive lead-safe habits among children.

The Chilean Poison Unit efforts raise awareness about toxins in the environments among those of higher socio-economic class. In the case of lead contamination, it is most likely that vulnerable individuals are of a lower socio-economic status, illiterate, and have limited access to technology. It is hence more important to focus on a campaign that addresses those in these

circumstances. The United States has lead campaigns that require technology and funding, as shown by the Central New York Poison Control Center that are also proficient at providing low income communities with health risk prevention education and materials at a low cost. Raising awareness about secondary prevention methods, such as lead-safe remediation practices and protective measures among both vulnerable citizens and those in a position to bring about social change is the best strategy to remedy lead exposure.

Chapter 5: Recommendations and Conclusions

After performing a complete analysis of all of our acquired research and data, we designed a set of recommendations that serve as steps towards lead poisoning prevention in Klong Toey and similar urban Bangkok communities. These suggested prevention methods follow the best practices for contamination remediation and health education campaigns in accordance with the sponsor needs and cultural context.

Overall, we identified the primary issue surrounding lead contamination in Bangkok to be a lack of awareness concerning lead and its associated health risks. With this information, we identified two broad audiences to direct our awareness efforts toward: Thai legislators and the general public. Additionally, within the general public we recognized that two groups at increased risk of lead poisoning. The high-risk citizens include Thai contractors and children under the age of six, as well as their parents and teachers. These target audiences were reached through our sponsor, the Duang Prateep Foundation. We also provide the Foundation with site-specific recommendations to remediate the lead contamination within their nursery.

5.1 Thai Legislators: Governmental Regulation

In the interest of public health it is critical for appropriate regulations on both lead levels in paint and lead removal practices to be developed and enforced. By preventing lead contamination and then regulating the remediation process, the threat of lead poisoning in Thailand can be thoroughly addressed. However, the Thai government is not currently giving priority to lead-based paint contamination remediation in legislative efforts. Therefore, any policy changes regarding lead-based paint in Thailand will not be immediate, but rather occur over a prolonged period of time. While the time frame for legislative action regarding lead-based paint is unclear, the Thai government was successful in the past in phasing lead out of gasoline, thus it is potentially capable of phasing out lead paint.

In addition to our full report, we have provided an abridged version of the information presented in this report, focusing mainly on the prevalence of lead in Thailand and the negative effects of lead poisoning to society. As detailed in section 4.4, *Addressing Public Policy*, our group has given a presentation of findings from this project to the BMA. **However, the project team recommends that the Duang Prateep Foundation use this abridged report as a policy manual to provide evidence and support in further lobbying for government action on the**

issue of lead remediation. The manual is designed to provide a significant amount of information and data that the Foundation can use to urge the government to take action. A copy of the policy manual is located in Appendix C-1.

Additionally, **we recommend that the Duang Prateep Foundation consider collaborating with the press on an informative article for publication in a Bangkok newspaper**. This publication will raise awareness and attention about the issue of lead, and has the potential to attract more governmental concern and investment. Proactive publicity will also help demonstrate the positive initiatives of the Duang Prateep Foundation in combating lead contamination, and enhance their leadership role in lead-based paint abatement. For this reason, we encourage the Foundation to publish an article after they begin remediation efforts at their nursery.

5.2 General Public

Regardless of age, economic status, or level of education, our findings indicated that the general public of Bangkok seems to be unaware of the presence of lead in their day-to-day lives and its associated health risks. This lack of knowledge places these citizens at an increased risk of contracting lead poisoning. Bangkok residents who live or work in areas of lower socio-economic status, or who are affected by yearly flooding, are at an even higher risk of contracting lead poisoning. This is because impoverished individuals are more likely to buy cheap lead-based paint and to prolong renovation of chipping lead-based paint due to budget limitations. Still, individuals able to afford and implement lead-free measures may also be at risk of lead exposure because of a lack of awareness about the dangers of lead. It is therefore critical to educate the general public about these risks and subsequent lead poisoning protection measures.

Based on these conclusions, we suggest the following for the Duang Prateep Foundation: First, **we propose that the Foundation organize public announcements concerning lead using the local intercom system during the morning and evening news in Klong Toey**. This announcement can contain basic information about lead and simple measures that can be practiced daily to prevent lead poisoning. The announcement must be carefully worded as not to unnecessarily alarm any of the citizens. **Through these announcements, we suggest the Duang Prateep Foundation invite community members to an informational seminar hosted by the Foundation to communicate lead safety information.** The visual seminar will target the adults of the community because they are, of course, the providers for and of the children, who are

especially vulnerable to lead poisoning. The seminar will detail information on lead, associated health dangers, how to identify possible lead-based paint sources, in-home methods for lead poisoning prevention, instructions for reading paint cans, and contact information for people who need to hire lead-safe contractors. We provide a script for this announcement, as well as an outline for the seminar in Appendices C-2 and C-3, respectively. **We also suggest the Foundation supplement this informational seminar by placing informative posters around the community and distributing pamphlets to community members.** Provided in Appendix C-6 are examples of possible posters.

For children within the general community, **we suggest the Duang Prateep Foundation's nursery learn and perform a skit or puppet show concerning lead and related hygiene practices**. This skit can encompass ideas such as the importance of hand washing, staying away from peeling paint, and telling an adult if they feel sick.

Additionally, **we suggest that the Duang Prateep Foundation create a page on their website that presents information about lead-based paint as a source of lead poisoning and also provides contact information for afflicted citizens.**

5.3 High-Risk Populations

Within the general public, our team identified two distinct populations who we consider to be in the high-risk category for lead exposure and poisoning. These include Thai contractors (and their families) and youth attending child-occupied facilities, especially those under the age of six. Additionally, to effectively protect children under the age of six, awareness recommendations were also directed at parents and teachers who cared for these vulnerable children. The following sections detail recommendations that raise awareness and to these specific groups.

~~5.2.1~~5.3.1 Contractors

Experienced contractors in the Bangkok area have adequate knowledge on the differences between oil-based and water-based paints, as well as their respective removal processes. Because most oil-based paints have notably high concentrations of lead (UNEP, 2011), it is important in this study to focus on oil-based paint removal methods in addition to lead decontamination. While in general different contractors follow comparable processes to remove oil paint, there are small differences in each contractor's individual method. The varying methods make it

challenging to address the changes that need to be made to one process; therefore, we recommend to the Duang Prateep Foundation that proper standards for lead-based paint be communicated to the building trades industry.

Many contractors have a basic understanding of the dangers that lead poses to humans. However, the severity of the risks are not widely understood, and thus not placed as a priority. We believe that contractors will take more interest in the problem of lead-based paint if they are aware of the occupational health risks it poses to their workers. **We recommend the Duang Prateep Foundation help protect Thai citizens, and especially the vulnerable contractors, by communicating the health risks associated with lead-based paint.** By emphasizing the severity of symptoms and the importance of preventing exposure, the Foundation can motivate hired contractors to follow lead-safe practices.

The proper renovation methods of lead-based paint and the choices of products used by the contractors are limited by their budget. Oil-based paint is attractive to owners because of its lower cost. Due to the strong correlation between high lead levels and oil-based paint, many contractors hoping to stay within budget inadvertently buy lead-based paint. Limited budget also results in low-cost toxic removal solutions being used. **We recommend that the Duang Prateep Foundation encourage contractors to relay the dangers of lead-based paint to owners so that a higher budget will be dedicated to purchasing safe lead-free paints and solvents.**

The above three suggestions can be simultaneously fulfilled in an inclusive educational campaign. Along with publications, live demonstrations, and video, **we recommend that the Duang Prateep Foundation develop an educational seminar geared towards contractors.** Several topics should be included in this seminar, including the role of occupational safety by use of Personal Protective Equipment and environmental safety by containment during the removal processes. Providing material on effective and safe decontamination methods will allow the Foundation to empower the targeted audiences. An outline of this seminar is detailed in Appendix C-4

The project team recognizes that the Duang Prateep Foundation can provide only a small part of the education that the contractors require. Considering that there are national resources, from the industry, government and non-associated groups such as the Lead Fighting Team, **we recommend providing contacts for contractors to get in touch with to gain more information.** This list of resources is provided in Appendix C-5.

~~5.2.2~~5.3.2 Teachers

Based on our interviews and surveys, an overall problem at the nursery is a general lack of knowledge surrounding the subject of lead exposure. The teachers we interviewed had varying understandings about the sources of lead and the subsequent side effects. **Based on this information, our team recommends that the Duang Prateep Foundation host a seminar for the teachers so that they can learn more about lead, its health effects, prevention methods, and recognizing lead poisoning symptoms in children.** We have provided a document that outlines seminar materials, which can be found in the Appendix C-3.

Additionally, we established that visual learning is the best teaching approach for all targeted audiences associated with the Klong Toey nursery. This was based on the interviews we had with the teachers and the principal in which we learned that most community members were illiterate. **We recommend that the nursery have visual posters displayed to communicate the potential dangers of lead around the nursery for the teachers, parents, and students.** An example of a poster is provided in Appendix C-6.

~~5.2.3~~5.3.3 Parents

Similar to the teachers, parents of the nursery students have displayed a lack of knowledge on the subject of lead. They have also shown interest to learn more about the topic in order to keep their children safe. **In order to educate the parents on lead, we recommend that the Duang Prateep Foundation host an informational meeting or presentation, given by the teachers and regarding lead.** We suggest that the teachers use their newly acquired knowledge and follow a similar format as is provided in Appendix C-3. While this meeting will target all parents, both literate and illiterate, we also recognize that some parents may want to have written literature to reference in the future. In order to provide parents with reminders about proper hygiene practices, **we recommend that pamphlets be created so that children can continue to practice appropriate hygiene at home with their parents outside of school grounds.** Of course these pamphlets were designed in a way that would not bring alarm to anybody. Televisions and radios were other viable means of communication. However, these methods were ruled out because we could not guarantee that the parents possessed these items in their homes. An example of a pamphlet, printed both in Thai and English, is provided in Appendix C-7. The Duang Prateep Foundation has a television that parents and children at the nursery can use. **For this reason, our team suggests that the Duang Prateep Foundation create a video**

that can teach both parents and children about the dangers of lead and proper hygiene practices. Due to financial and time limitations, we did not test for cases of lead poisoning in the students at the nursery; however, this does not indicate that there are no lead poisoning cases. In order to protect the children in the nursery from this, **we advise that the Duang Prateep Foundation have hospital contact information available to teachers and parents in case of possible lead poisoning.**

~~5.2.4~~5.3.4 Children

It is important to select an effective way for the kindergarten children to learn the risks and significance of lead and lead prevention due to the fact that they are the most susceptible to the severe consequences of lead poisoning. However, because of their level of development, it is difficult for children to understand the hazards of lead and how to appropriately avoid them. **Our team recommends that the nursery collaborate with the parents of the students to perform short puppet shows or skits for the children in the nursery**. These shows can include material about avoiding peeling paint, good hygiene practices, and encouraging children to tell an adult when they feel sick. By performing a fun and educational puppet show, it is easier for the children to absorb information on simple prevention methods. Some of the older children who attend the nursery may also be able to participate in the performances, which help to reinforce the importance of the issue. Other than puppet shows organized by the nurseries, **we also suggest the teachers of the nurseries develop new hygiene games for the children to participate in**. The hygiene games are designed to emphasize the seriousness of lead poisoning without alarming any of the children about the topic. These hygiene activities will further impress upon the children the significance of practicing good hygiene to avoid becoming ill.

~~5.3~~5.4 Duang Prateep Foundation Nursery

The overall goals of this project are to educate stakeholders about protection measures against lead exposure and poisoning and to permanently eliminate lead-based paint from the environment in urban Bangkok communities. Both of these must also occur within the specific case of the Duang Prateep Foundation nursery. The Duang Prateep Foundation, with much experience in community organizing, is well equipped with the resources and recommendations of this report to implement a thorough educational program. To directly address the current lead levels detected in the kindergarten, **we advise that the Duang Prateep Foundation pursue**

proper lead-based paint removal methods promptly. In the meantime however, they are advised to protect the walls from abrasive activity that may further the flaking and dispersal of paint particles. These actions could include isolating areas where lead paint is flaking and painting over undisturbed walls. The health risks posed by lead, specifically to vulnerable children, will not be lessened until the toxin is properly removed. **We therefore recommend the Duang Prateep Foundation verify that the contractors hired for removal of future incidents of contaminated paint are certified to safely and effectively remove lead-based paint.** By placing an emphasis on hiring a contractor certified to safely remove lead-based paint, the Duang Prateep Foundation will set a model example for other agencies and will proactively lead future efforts to create a safe lead-free environment for the public. **Additionally we recommend that the Duang Prateep Foundation continue to use lead-free paint that meets the national lead standards and encourage surrounding nurseries to follow in their footsteps when repainting kindergartens.**

~~5.4~~5.5 Conclusions

These recommendations were proposed to enable Thai citizens to protect themselves against lead poisoning within urban Bangkok communities. The recommendations are based on an assessment of the proper methods of lead-based paint removal and means of protection from lead exposure, along with an analysis of their applicability within the slum within Klong Toey. In order for our recommendations to be sustainable, the Duang Prateep Foundation must work closely with both government officials and local community members. Involving the community on multiple levels will support community members to take personal initiative in protecting themselves until stricter legislation emerges. Through the implementation of these recommendations, the Duang Prateep Foundation has the potential to become a leader in the efforts to address lead contamination and lead poisoning prevention in Thailand.

In carrying out this collaboration with the Duang Prateep Foundation, close cooperation between the Thai and American students was invaluable. The Chulalongkorn University students especially aided the Americans in understanding Thai culture, which helped our team display proper customs and courtesies during interviews and surveys. Additionally, this insight allowed the team to successfully communicate with members of the Duang Prateep Foundation. We held several meetings with executive members of the Foundation and from these meetings we found especially poignant the goals of the Foundation in empowering impoverished citizens across

Thailand. Our appreciation of these goals compelled us to become even more dedicated to the project.

Our emotional investment in this project deepened greatly when we visited the Foundation's nursery school to evaluate the lead contamination and we observed the students putting their hands in their mouths on multiple occasions after touching the walls and floor near deteriorating paint. Seeing first-hand hand the very real possibility of these children contracting lead poisoning, our sense of obligation and responsibility toward vulnerable community members grew. We became personally committed in aiding the Klong Toey slum community to understand the reality of lead contamination and the preventative measures that should be practiced in their daily lives.

While our aim for this project was specifically to raise awareness about the potential health effects of lead poisoning for urban communities in Bangkok, we recognize that lead contamination is a problem throughout the entire nation of Thailand, as well as worldwide. We believe that through the successful completion of this project we have already made notable progress in bringing the issue to the attention of the Bangkok Metropolitan Administration; this is the first step in encouraging the development of legislation necessary for the complete mitigation of lead contamination. We are therefore optimistic that our results, in combination with the great influence of the Duang Prateep Foundation, will play a role in the development of stricter laws and regulations regarding lead paint in Thailand and other developing nations.

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Appendix A-1: Interview Questions for Local Contractors

The following is a set of questions used to conduct a *semistandardized* interview with local Thai contractors (the interview was conducted in Thai):

1. How do you remove paint?
2. What are the differences in procedure in removing oil base or water base paint?
3. How and where do you learn these techniques?
4. How do you select the paint that you use for repainting?
5. What are the protective gears you or your worker wear while removing paint?
6. Do you know the effect of dangerous of lead

Appendix A-2: Interview Questions for Ramathibodi Hospital Doctor

The following is a set of questions used to conduct a *semistandardized* interview with a Dr. Adisak Palipolkampim from Ramathibodi Hospital, Thailand (the interview was conducted in Thai):

1. How prevalent is the issue of lead poisoning in Thailand?
2. How often do you test patients for lead poisoning?
3. How do you diagnose lead poisoning, what are some of the worst cases you have see in patients, especially children?
4. How many cases of lead poisoning do you see yearly?
5. What do you think is important for the community to know about lead poisoning, especially what do think is important for children to know?
6. Do you feel it is important to teach the community about lead poisoning? Can you suggest suitable media for teaching this information?
7. Are you working to publicize this issue/would you like to raise more awareness about this issue?
8. Can you explain the purpose of your study?
9. Can you tell us more about the program you have to train doctors in lead poisoning prevention and diagnosis?
10. Whose responsibility do you feel it is to protect, inform, and educate the general public about this issue?
11. Where does this problem stand in terms of your priorities (most important, least important issue?)
12. Do you have any international support or assistance on this work?
13. Based on the work you have done, do you feel you are making progress in fighting this issue? For example, lead gasoline has been eliminated; do you think this is a possibility for paint and if so what sort of timeline do you expect?

Appendix A-3: Interview Questions for Lead Fighting Team

The following is a set of questions used to conduct a *semistandardized* interview with a leader of the Lead Fighting Team, Thailand (the interview was conducted in Thai):

1. Explain how the lead fighting team was chosen/how did this project come about?
2. What was the process for removing the lead?
    a. Was the team given specific removal instructions?
    b. Who gave the team instructions and where did these instructions come from?
    c. Is this the first time the hospital has done a project like this one?
3. What was your budget for this project?
4. Did you collaborate with any other ministries, companies, hospitals, or teams?
5. Could you recommend a qualified Thai contractor to do lead removal for buildings that do not have a high budget?
6. What would you suggest organizations experiencing this issue do? What course of action should they take?

Appendix A-4: Survey Questions for the General Public

The following is an English language version of the survey that was presented to willing participants of the general public of Bangkok (the survey was conducted in Thai):

1. What is your age?

☐ Below 20 ☐ 21-30 ☐ 31-40 ☐ above 40

2. What is your level of education?

☐ High school or lower ☐ Bachelor's Degree ☐ Master's Degree

☐ PHD or higher

3. Do you have children under 6?

☐ Yes ☐ No

4. Have you heard of the toxin, lead?

☐ Yes ☐ No

5. Where do you think lead can be found? (Check more than one option)

☐ Light Bulb ☐ Paint ☐ Pencil Lead ☐ Newspaper

☐ Battery ☐ Plastic Bags ☐ Exhaust Gas ☐ None of the Above

☐ I don't know

6. How do you think lead enters the body?

☐ Skin Adsorption through contact ☐ Inhaling Dust ☐ Eating with hands

☐ ☐ ☐

Injection None of the above I don't know

7. How well do you think your government is taking care of the lead issue?

☐ Very Well ☐ Fine ☐ Bad ☐ I don't know ☐ I don't care

8. After this survey, are you interested to find our more about the dangers of lead?

☐ Yes ☐ No

Appendix A-5: Survey Questions for Teachers

The following is an English language version of the survey that was presented to willing teachers from the Duang Prateep Foundation (the survey was conducted in Thai):

Lead Prevention and Mitigation Evaluation Project

Chulalongkorn University and Worcester Polytechnic Institute

Please answer all questions as instructed. This survey will remain anonymous.

1. How long have you worked as a teacher for the Duang Prateep Foundation?

   _____ years _____months

2. Are you aware of the lead contamination issue in the nursery?

   _____ Yes _____ No

4. Please explain your knowledge level on lead poisoning both before and after the contamination. In other words, what have you learned about lead since the contamination?

   Before:

   After:

5. Have you observed any of the following behaviors in the children that may increase their risk of lead poisoning? Please circle any that apply.

   Putting hands in mouths

   Crawling on the floor

   Putting toys in mouths

   Eating food off the floor

   Touching the walls

   Other: _____

6. What do you think are the differences between lead contamination and lead poisoning?

7. What do you think are the symptoms of lead poisoning?

8. Would you be interested in participating in a focus group about lead prevention education? If so, please sign a separate sheet.

Please use the space below to add any comments or questions you have for us.

Thank you for your time and patience with the survey and us. Your answers will assist us in our research.

Appendix A-6: Interview Questions for Teachers

The following is the set of interview questions that was presented to several willing teachers from the Duang Prateep Foundation (the interviews were conducted in Thai):

1. What is your name?
2. How long have you worked at the Duang Prateep Foundation?
3. How often is the nursery cleaned?
    a. The walls
    b. The floor
    c. The toys
    d. The Bathrooms
4. Does the school have a certified nurse or someone with a medical license that can attend to the children if need be?
5. Is the nurse aware of the potential harmful effects that lead paint can have?
6. Generally speaking, what are your interactions with the children's parents?
7. Do you have parent-teacher conferences?

Appendix B-1: Lead-Based Paint Removal, EPA

Step-By-Step Process as published in Steps to Lead-safe, Renovation, Repair, and Painting by the United States Environmental Protection Agency (HUD, 2011).

Step 1- Determine if the job involves lead-based paint: This step works to detect the presence of lead-based paint in target homes. All the different surfaces that will be disturbed must be tested for the presence of lead. This is because while one wall may be lead-free the window sills located in the same room may not be. The testing method that is approved by both the Environmental Protection Agency and Department of Housing and Urban Development is done using an X-Ray Fluorescence Analyzer (XRF). This machine tests paint chips for the presence of lead in the sample. A sample that tests positively for the presence of lead requires the renovators to proceed and implement steps two through seven.

Step 2- Set it up safely: Ensures that the work site is properly contained. The work area must first be established in order to prevent the haphazard dispersal of lead paint chips, debris, and dust into the air. Indoor sites and outdoor sites follow different requirements to ensure proper containment of the work area. The EPA requires that indoor construction sites encompass the direct construction site and all areas extending 6 square feet from the site. In outdoor construction sites the work area consists of the exact site parameters and all sites that extend ten square feet from it. These precautions ensure that surrounding residents and facilities are not threatened by potential construction debris.

Step 3- Protect your-self: Workers must wear the correct equipment to protect themselves from ingesting or inhaling lead and to prevent themselves from acting as potential vectors. They therefore must wear protective gear that covers the worker from head to toe. Hats, gloves, overalls, and cover shoes are all important to wear on the job. In addition the mask is always the last part of the attire that will be removed by the worker in order to protect his mouth and nose from possibly inhaling and ingesting the material.

Step 4- Minimize the dust: All the methods used must be safe for the workers and surrounding people. They must also emit the least amount of debris so that the dust does not potentially accumulate in corners and in surrounding soil. As a result the EPA does not allow for heat guns over the temperature of 1,100 degrees Fahrenheit. This is because the process emits many fumes and sandblasting unless the machines have a HEPA vacuum attached to them.

Step 5- Leave the work area clean: Cleaning the work area is an important requirement of the renovation process in order to make sure that all the lead contaminants are always disposed of properly. The most important of which is the HEPA vacuum, which has a filter in it that does not allow for the lead particles to be released into the air and surroundings.

Step 6- Control the waste: Waste and debris must be collected and well secured into durable plastic bags. The collected waste must be sent to a hazardous waste dump where the hazard is appropriately contained. The lead is therefore further contained and not allowed to be released into the environment any further. The goal of this step is to ensure the amount of generated debris is minimal and contained. All furniture must be removed from the area and all openings secured to minimize the amount of dust generated in the area.

Step 7- Verify work completion with the cleaning verification procedure or clearance: This part of the process is done by using disposable wipes that are compared to a verification card. The wipes are used to clean the surfaces. The dirty wipe is then compared to the verification card to indicate how clean it is. The process is done over and over until it passes. The floors are also mopped and not swept. The mop head will absorb all the negligible dust particles on the floor by

applying equal pressure on the floor. Sweeping is not recommended because it has the ability to release the dust particles into the air.

Appendix B-2: Case Studies

New Zealand Case Study: Viability of Removal Methods

In 1997, a study in Wellington New Zealand was conducted to target the best of the lead removal practices. The study targeted children between the ages of twelve and twenty-four months living in homes that were older than fifty years. The various types of methods employed included chemical stripping, scraping by hand, sanding, electrical heat guns, water blasting, and blow torching. The study tested a total of 141 children, collected dust samples, and monitored adult activities in the house that might have affected the child's level of accumulated lead. When analyzing the aspect of the case study relative to the effects of lead abatement methods on the health of children it was found that they were all successful, except for high-temperature methods (Review of Studies Addressing Lead Abatement Effectiveness, 1998).

United States Case Study: Viability of Interim Methods

The "Boston Interim Dust Intervention Study" performed in 1998 reviewed the efficiency of lead contamination reduction by low-technology methods. In order to determine that there was environmental lead contamination, this study tested both lead-based paint and interior household dust in homes planning to perform permanent lead decontamination. The study of 63 children living in contaminated homes tested the children's blood-lead levels to be between 11 and 24 μg/dL before the study was followed.

Three subject groups were created: One with notable severe household hazards of lead while the other two split between intervention and comparison groups. Intervention strategies employed in the study included HEPA surface vacuuming, washing surfaces with a tri-sodium phosphate wash, fixing the holes in wall and repairing poorly maintained paint by repainting. In addition to interim remediation processes, educational intervention was also supplied to the families in all three interest groups. This educational material was concerning housekeeping, maintenance and dust cleaning.

Six months following the intervention procedures, the blood-lead levels of the children in severely affected homes declined by 48%. The randomized intervention group, receiving the abatement procedures, had a 35% decline in BLL. The study group only supplied educational material and no interim remediation, experienced an average BLL decline of 36%. It was noted for study limitations that 1) the blood-lead levels were possibly affected by the seasonal variations that would occur during the 6 months of testing and 2) the sample sizes were relatively small for the study and should have been larger to have a stronger conclusion from the results.

This case study is instrumental in understanding that there are effective interim methods that can lower children's' blood-lead levels before permanent lead-based paint abatement. The children, already experiencing elevated lead concentrations in the blood, lived in households of a range of maintenance levels. By applying interim methods, to only temporarily protect the inhabitants, blood-lead levels decreased over a six month period. Remediation in a home with extreme paint chips on the floor and large amounts of lead-contaminated dust, proved to be more effective in lowering blood-lead levels than in better maintained homes. It is important to note that when there was solely educational intervention, it was similarly effective to using the interim intervention methods. The low-technology lead-hazard reduction program reviewed in this study proved beneficial for children experiencing elevated blood-lead levels.

Appendix B-3: Australia Advantages and Disadvantages Chart

Table 4: Advantages and disadvantages of lead contamination removal methods in Australia

(Peel Away Australia-Asia Pacific, 2010)

Method	Advantages	Disadvantages
Do Nothing	- very cheap - safe if paint is in very good condition and not likely to be damaged by general wear and tear or chewed by children - very easy -no cleaning up - produces no lead contaminated waste	- need to inspect painted surfaces regularly to make sure the paint containing lead is still in good condition
Cover the paint containing lead	- safe if little preparation is needed - produces little lead dust - relatively fast - inexpensive - produces little or no lead contaminated waste	- painting over is suited only to surfaces in good condition - the paint containing lead is still there when you have finished the job
Remove painted items and replace with new	- very safe - can be fast - may be the easiest option for some odd-shaped surfaces, like skirting boards	- can be difficult or expensive to find replacement items to match existing items in some older houses - not always possible for heritage listed buildings - need to dispose of unwanted items in a way that complies with the relevant government regulations
Wet scraping/Wet sanding	- inexpensive - useful for dealing with flaking paint	- takes a lot of time and effort - can damage underlying plaster or soft wood if not done carefully - need to clean up and dispose of waste materials properly

Chemical Stripping	- produces little dust - relatively efficient	- cannot be done in a sealed room - the paint stripper can be absorbed into some surfaces - paint stripper is flammable and caustic - need to neutralize wood with acetic acid before repeating - paint residue can be sticky and difficult to clean up - need to clean up and dispose of waste materials properly
Dry power sanding with a HEPA vacuum attachment	- fast if done by a fully trained and experienced operator	- not safe for the home handy-person - can produce large amounts of dust if not operated properly - not suitable for removing paint from unevenly shaped surfaces, like cornices - need to clean up and dispose of waste materials properly
Low-temperature heat processes	- useful to soften very thick paint on flat surfaces	- potentially very dangerous - can burn the paint and produce lead fumes - need to clean up & dispose of waste materials properly

Appendix B-4: Details on Interview with Lead Fighting Team

As the head of the project and coordinator of the Lead Fighting Team, Professor Channarong Wayapoj at Kasestart University was interviewed to understand information on the current practices in Bangkok concerning lead. Because of his extensive knowledge on lead-based paint contamination, removal methods and BMA lead-paint testing, his input and discussion was helpful in many areas of the project. The interview yielded a description of the recommended lead-based paint removal methods practiced by the Lead Fighting Team. He also spoke about occupational safety when remediating lead paint and the regulations surrounding the paint industry in Thailand. This information prompted subsequent questions about the role of paint manufacturers. National paint companies are the only regulated part of lead-based paint in Thailand, therefore more detailed and substantive information was provided about the governmental standards.

The role, future goals, and associations of the Lead Fighting Team were explained to our project team. These objective included proper lead-based paint removal research and working with the national government towards creating stronger and enforced regulations. We also presented Professor Channarong with numerous documents related to our study of the Duang Prateep Foundation incident with lead contamination. He gave specific important details about the case at the Duang Prateep Foundation. Professor Channarong noticed that the Foundation initially painted with an oil-based paint, which contains a higher concentration of lead, therefore making it more difficult to remove from the walls. In addition, the contractor hired by the Foundation was said to have no prior instruction concerning proper lead remediation methods, but rather was hired locally. The Duang Prateep Foundation reasoned that after detecting lead in the walls of their nursery the logical solution would be to remove the paint and in essence directly remove the source of lead, unknowingly neglecting the health hazards presented by lead. Through our interview we also learned that the Duang Prateep Foundation was offered assistance from the Lead Fighting Team for lead decontamination. The proposition was declined however because the process was estimated to require about two months. A combination of the lack of widespread awareness of lead contamination and the lack of clear communication between the Foundation and the Lead Fighting Team, amounted to an independent attempt by the Duang Prateep Foundation to remove the lead. Unknown to the Duang Prateep Foundation, removing the lead-based paint was not sufficient enough to remediate the environmental lead contamination. Without proper consultation from professionals on effective lead-based paint removal the remediation process proved to be unsuccessful. Therefore, the information that was gathered and assessed from the interview with Professor Channarong Wayapoj provided insight not only to the situational details concerning lead contamination at the Duang Prateep Foundation's nursery, but also practiced lead-based paint removal methods and the nature of the paint production industry in Thailand.

The paint industry in Thailand is regulated by standards of lead levels, but the maximum toxicity levels are not compulsory. On paint cans in Thailand, labels have informational symbols advertising characteristics of the paint and the standards that the paint meets. Professor Channarong showed the team typical paint cans and pointed out the lead-safe symbols. These symbols are very small, no more than $3cm^2$, and are also on the back of the can's label. This poor visibility and poor public awareness of the label icon partially accounts for the lack of public awareness of lead-based paint.

Though lead-based paint dominates the market, the large paint companies, such as TOA, have developed effective methods to remove lead-based paint and provide certification courses

to safely remove the contamination. These methods are developed individually by the manufacturers and are specific to the brand. Professor Channarong explained that a large set of contractors do not enroll in these specialty courses because of time, cost, and interest. This last piece of information leads to the conclusion that ordinary contractors are uninformed about proper removal methods.

This lack of awareness of decontamination methods that are mindful of human health and the environment is demonstrated in the comparison of typical paint removal methods to the proper process implemented by Lead Fighting Team contractors. Professor Channarong emphasized the time commitment needed to properly remove lead-based paint. Also, noted was the critical difference between the processes to properly remove different types of paint; oil-based paint requires a more laborious and time-intensive removal process than acrylic paint. The method of removal explained in the interview to effectively remove lead was employed by the Lead Fighting Team multiple times with success.

Suggested Decontamination Process
Do not wash the wall with an acid
Collect solid waste in bags
Send waste to hazardous waste management facility
Curing of wall to set humidity standards before paint application
Adequate time (approximately 24hrs) for paint to dry

The process, as described, is typically not followed in full by general contractors in Thailand. From the observations of Professor Channarong, a contractor will be keen to complete a project and then move on to more projects, placing time over careful removal. The implications of this mean that contractors will take short cuts in the removal process by quickly scraping off the paint and not allowing the full and proper drying time.

Also critical for understanding the regional practices of lead-based paint removal was an account of the contracted workers and their personal protective equipment (PPE). We learned that, in general, contractors rarely wear full PPE; they usually only wear a face-mask. This toxin exposure is extremely dangerous to the workers who are ingesting high concentrations of lead in the removal process. In addition, lead dust is highly mobile and the exposed workers can act as a vector tor, bringing the contamination home to their families. In comparison to the typical occupational safety practices seen in Thailand, the Lead Fighting Team required that its workers use full PPE, including goggles, face mask, gloves and a hazardous materials suit. This consideration for workers' health further emphasizes the role of the Lead Fighting Team as an important example for future implementation of lead-safe removal methods.

Professor Channarong was familiar with the Duang Prateep Foundation and the lead contamination in the kindergarten. He was therefore able to recall the case and explain details. After evaluating the data analysis of lead toxicity levels at the Duang Prateep Foundation kindergarten, Professor Channarong confirmed that the methods of removal were probably the primary reason for the toxicity increase. Discussing the use of paint types, he reiterated that oil-based paint remediation and removal takes much longer than water-based paints. Safe removal methods require the contaminated building to be shut down for 2-3 months, which would

potentially mean the students losing a large portion of their school time. When presented with the first positive testing of lead, the Duang Prateep Foundation acted to promptly remove the source of toxicity to protect the health of the children. The valuable schooling time could not be sacrificed for a long process of decontamination and therefore a shorter paint removal option was chosen. A “quick” and safe decontamination, as understandably desired by the Duang Prateep Foundation, was impossible because of the nature of oil paint. Even if a hired contractor was trained to remove paint, those methods are not effective enough to remove lead as well.

Appendix B-5: Details on Interviews with Thai Contractors

We interviewed five general contractors in Bangkok to observe their standard removal and repainting procedures, their method of choosing painting materials, and the safety precautions they take. The procedures used by each interviewed contractor revealed that they used similar methods to remove paint from the wall and to repaint the walls. Most of the contractors began by wiping down the walls with a cleaning agent or a solvent that would reduce adherence between the paint and the wall such that the paint could then be easily scraped away from the surface of the wall. Before the scraping process could begin, the workers had to wait several days for the solvent to dry. Some contractors expressed that it is more expensive to use a solvent to aid paint removal processes; these contractors who do not use a solvent simple scrape away the paint after washing the walls. An adhesive paint binder is then applied to the wall before a new coat of paint is applied.

Every contractor mentioned that there is a difference in removal processes when dealing with water or acrylic-based paints versus oil-based paints. The contractors use a different chemical solvent to aid removal of paint from the walls depending on the type of paint. All of the contractors were aware that there are some precautions that should be taken to protect themselves from the chemicals used in the removal process and particularly from lead found in oil-based paints; however they only wear a mask that covers the nose and mouth or neglect protective gear all together. The masks generally used are face masks made of paper loosely covering the nose and mouth, inadequate protection against fine dust particles. Because of the prioritized and limited budget of contractors, the accessibility and additional cost of proper PPE, occupational safety is not always considered.

Most of the contractors interviewed stated that the removal and repainting methods they use are obtained from their own experience. They are aware that some certified contractors in Thailand have been instructed on proper removal and repainting methods by specific paint companies such as TOA and Pammastic. These large paint companies are often faced with lawsuits regarding defects in the paint, or lead in the paints. They often defend themselves by evaluating the procedures the contractor used to repaint, remove, or initially paint their products. They also closely examine quality control methods used within their company and the data their quality control teams obtained.

Additionally contactors are commonly faced with choosing a chemical solvent and paint type for a job. Occasionally a client will specify the paint type they would like to be used, however they more often put trust in the contactor to make the right decision for them. The contractors we interviewed all have varying budgets, which determines the type of paint they buy for a job. Contractors that have a connection with a paint company do not have to worry about price, but those without a connection often go for a cheaper oil-based paint which is more likely to contain lead particles and takes a longer time to dry.

The interviews with Thai contractors provide us with understanding of each of their standard paint remediation process, their method of choosing material, and the safety equipment they use while removing paint from walls. All mentioned that they have developed individual methods of removing and repainting from their own experiences. We can conclude that this is because the Thai government has not yet established a definite standard for proper paint remediating processes. All of the contactors interviewed used very similar processes which were targeted towards efficiency and their budgets. Each contactor seemed to neglect cleanliness of removal, concern for the environment, and themselves, by not using proper protective gear. The

main difference noted between contractors' removal methods is the amount of time they decide to wait for the walls to dry before removing paint chips from the wall.

The budget for selecting materials was the biggest issue emphasized by most Thai contractors. Money provided by the homeowners was often not enough to afford acrylic paints or lead-free paints, therefore oil based paints are mostly used in common houses. This is mainly because oil-based paints are cheaper compare to acrylic or lead-free paints. Moreover, people in Thailand are not aware of the fact that oil-based paints contain lead.

Most of the contractors acknowledge the dangers of working with lead and about lead poisoning. However, they generally do not follow the suggestion regarding safety precautions from the site managers because the contractors are not obligated to by law. Furthermore, everyone can do this job because there is not any compulsory training or official certifications for this particular job in Thailand. After interviewing these Thai contractors we can conclude that Thailand is in need of regulations and standards that the contractors must follow in order to protect themselves and the home or building owners clients.

Appendix B-6: Details on Surveys with the General Public

We conducted a survey to understand the current level of awareness about lead poisoning in Bangkok. The surveys were handed at random to people in the Klong Toey area, Chulalongkorn campus, and Charmchuree Square. A total of 80 surveys were collected that represented a wide age distribution and level of education of respondents; ranging from 20 to above 40 years old and from high school or below to people with a bachelor degree or higher. Parents of children studying at the Duang Prateep Foundation were also given the same survey to comprehend their level of awareness.

Based on the findings from the 80 surveys we gathered, 29 participants noted that they do not know or have not heard about lead and its negative health effects. On the other hand out of the 51 people that claimed to know about lead, only five of them noted accurately the effects of lead poisoning, the sources of lead, and how one contracts lead poisoning. The most prominent misunderstanding that our surveys revealed was that lead dust was thought to be absorbed through the skin. The majority of the respondents know that lead is present in gasoline and batteries, while less than half of the respondents identified paint as a source of lead.

The public's opinion regarding government involvement in lead contamination and decontamination varied. The majority of the respondents expressed that they do not know about the government's involvement concerning laws and regulations on lead. Other respondents believed that the government was not doing a sufficient job in enforcing proper regulations. The minority of respondents expressed a confidence in the government and their efforts regarding the prevention of lead poisoning and lead contamination. Additionally, all but two participants were interested in learning more about lead contamination, the sources of lead, and how to prevent lead poisoning.

Our findings suggest that our participants had little to no knowledge about lead. The twenty-nine respondents that indicated that they have never heard of lead problems included people with all levels of education and age groups. We hence understand that the widespread lack of knowledge concerning lead contamination is not dependent on age or level of education.

In contrast to the above results, one surprising answer we gathered from the survey was that the majority of the people knew about the presence of lead in gasoline. This is because lead in gasoline was a widespread problem in the mid-90s. The Thai government banned the use of lead in gasoline by promoting the use of gasohol. In spite of this, the surveys indicated that most people were not aware of the presence of lead in paints is of equal concern.

Additionally, the survey indicated that the majority of respondents were not familiar with how lead enters the body. Most of them answered that lead is absorbed through skin, which is not a possible vector for lead poisoning. In fact, inhalation and ingestion are the only methods by which lead can enter the body; citizens must understand this fact to combat lead poisoning. Moreover, the lack of awareness among parents who had children under the age of six was of immediate concern because parents are critical in preventing lead poisoning among children.

Most respondents were either dissatisfied or unaware of the efforts and role of the Thai government in managing exposure to lead sources. We have deduced that the lack of awareness among the general community members is due to the limited efforts by government officials and authorities to reduce lead exposure by promoting lead-free products. Still, a great number of people expressed interest in educating themselves, which reinforces our objective of raising awareness through educational campaigns.

Appendix B-7: Site Assessment Observation

The kindergarten run by the Duang Prateep Foundation is located in the heart of the Klong Toey slum. The children who attend the school live in the vicinity and are between the ages of two and six. There is a span of ages in a single classroom, based on the Montessori teaching style. As a full-day nursery, the children arrive in the morning with their parents to the Duang Prateep Foundation and are picked up in the early afternoon. The young children are required to wear a school uniform (see Figure 8). Street shoes from home are placed in the children's individual cubbies when they change into new shoes specifically used in the school, though in the actual classroom children are barefoot. Montessori education is used at the Kindergarten; the children are allowed to pursue the various educational activities available to them in an open classroom.

Figure 8: Students are lined up for lunch and dressed in uniform

The classroom is open-air and along the three walls are shelves at the children's level stocked with learning tools. The children are taught to take the educational activity and use it on a rug on the floor. Most children will independently use the material for self-learning and creativity. After contemplating one activity, the child will roll up the rug and will replace the material on the shelf before taking something new. The free style of education at the nursery presents multiple opportunities for the children to be independent. Not surprisingly we observed multiple times during our observation session that the children would put their hands and other materials in their mouth, a typical behavior for the age ranges in the nursery. Throughout an activity, the teachers for each class interact with the students, sitting on the floor with the children and helping them.

Before mealtime the teachers will usher all the children to lie out their blankets on the floor (see Figure 11), wash their hands in the bathroom and put on their shoes. In addition to toothbrushes, there are washcloths for the children to dry their hands. While the teachers have taught the children how to properly wash their hands and there are posters above the sink, we observed that many children would quickly rinse their hands with water and run back to the group. The children will then line up and proceed to lunch (see Figure 9). The teachers do not shout to the entire class, but speak to the children quietly and in small groups ask them to do a task. The lunch area has low children's tables where the kids sit in long rows and are supervised by the teachers. After the meal there is "play time" when the children play in the yard. The activities in the yard include a playground with slides and swings, as well as loose tires (see Figure 10). The children will naturally play with each other and on the ground. After recess they nap in their classroom until their parents pick them up.

Figure 9: Children eating lunch at the Nursery

Figure 10: Children playing on the playground at the Nursery after lunch.

Figure 11: Children at the Nursery laying down blankets.

The goal of the kindergarten observations was to analyze the education on hygiene at the Duang Prateep Foundation school for implications for both lead exposure and to identify high-risk habits. There were two general ideas evaluated: educational method and hygiene practices.

The Montessori educational system allows the children to initiate learning by following their instinctive psychological development (Rathunde, 2001). The instructive style in the school encourages the children to teach themselves, which was highlighted by our observations of peer-learning. Because of the mixed aged classrooms, older and more experienced children are apt to assist younger students in learning. Instead of direct education and curriculum as found in a traditional classroom setting, the role of the teachers is to emphasize self-learning. This results in the teachers playing largely a supervisory role. The personal and individual contact that the teachers have with the children is effective for young-age development (Rathunde, 2001).

While academic subjects are taught in the Duang Prateep Foundation Kindergarten, there is a large emphasis on life skills and hygiene practices in the curriculum. The effect of the Montessori educational method is that the children do not necessarily follow proper hygienic practices on their own. Before the students go to lunch many did not practice the hygienic skills that they had been taught. This allows for direct ingestion of lead, as one of the basic prevention methods of lead poisoning is to wash hands. Potentials for lead ingestion are also presented by the natural habits of young children. The younger students will place objects in their mouth and play on the floor and dirt ground. If there is exposure to lead contamination through the environment, as demonstrated in the Duang Prateep Foundation Kindergarten, the activities of any child will be a pathway for toxicity.

Though there are understandable gaps in hygiene practices, we observed that the Duang Prateep Foundation nursery has exemplary health and cleanliness practices. The students do not wear shoes in the immediate classroom, but leave the dirty shoes outside in the hallway. There are also many personal health practices that are taught to the students. These are especially important to the children at the Foundation's nursery, as safe hygiene is taught to them at a very young age and will be important throughout their lives.

Appendix B-8: Details on Surveys of Teachers

In order to achieve our fourth objective of designing an educational campaign we utilized three methods; we conducted a survey, interviewed teachers from the Duang Prateep Foundation, and researched successful education campaigns as case studies.

On January 25, 2012, our team visited the nursery at the Duang Prateep Foundation to conduct a survey with the teachers. The point of the survey was to gather information on the teacher's level of knowledge concerning lead. During the survey, the teachers stated the survey was difficult and they felt there was not much they could contribute due to their lack of knowledge on the subject. The survey was completed in two sessions as some teachers needed to watch the children while the others took the survey. In all, thirteen teachers finished the survey, which were collected by our team.

After reading and analyzing the results, we found that the answers were highly varied in content. Our team gathered from question one that all of the teachers have worked at the Duang Prateep Foundation for a varied number of years (see Appendix A-5for survey questions). One teacher worked at the Duang Prateep Foundation for seven months, while another teacher worked there for thirty years. It was found that all teachers knew in general that lead presented a health problem, indicated by question two. Question three is where our team noticed the answers becoming highly varied. When asked if they knew what the effects of lead were before and after the discovery of lead contamination at the nursery, subject ten wrote that lead comes from utensils and toys, while subject five wrote that lead comes from the walls. Almost all of the teachers noted somewhat unsurprisingly that the children put their hands in their mouths, while the rest of their answers to question four were different. When asked on question five, most of the subjects understandably could not surmise the difference between lead contamination and lead poisoning. Most of the teachers did not attempt to differentiate between the two; instead they used only one sentence to describe the effects of lead. On question six, the subjects wrote down many different symptoms of lead poisoning, such as skin irritation and cancer. The only common answer that many of the subjects shared however was that they believed lead poisoning causes mental defects in children. Following question six, question seven asked if the teachers would be interested in participating in a focus group and only three of the thirteen subjects displayed interest. Lastly, on question eight, many of the teachers showed interest in learning more about lead poisoning and lead contamination.

Appendix B-9: Details on Interviews with Teachers

In order to conduct our interviews, our team visited the Duang Prateep Foundation and the nursery on January 31, 2012. We decided the most efficient way to perform the interviews was to split into two teams of two and run the interviews simultaneously. The interviews took approximately an hour and thirty minutes to complete. Our interview questions were divided into two different sections. The first section was designed for the head teacher and principal and the second set was designed for the teachers.

The principal and head teachers of the Foundation were interviewed simultaneously and it was found that their answers were very similar. Both the principal and the head teacher have been working at the Duang Prateep Foundation for over thirty years. When asked about the cleanliness of the school the response was the same: The floors are cleaned three times a day, the walls once a week, the toys once a day, and the bathrooms twice a day. When asked about whether or not the school had a certified nurse, they responded by saying that the school used to have one but due to budgetary concerns, they no longer have one. Instead, all of the teachers are trained in first aid every year. The principal also mentioned that she is certified to teach first aid to her teachers. During the day when the teachers are being trained, the children usually have their check-up so the teachers can practice their first aid skills. There is also a local pharmacist who supplies the school with first aid kits, according to the head teacher. Our team received different answers from the head teacher and the principal, once we asked question five, which asked what the interactions are like between parents and teachers. The head teacher told us that they interact with each other briefly in the morning and the afternoon. There are also parent-teacher meetings twice a year at the beginning of each semester. She also mentioned that sometimes the parents won't come to pick up their children because they are having problems at home. The teacher will go to the parent's home and try to resolve the problem. The teacher had these same answers but added that the teachers will give parents advice on how to help their children but the parents will sometimes ignore the advice given. If their children have a type of mental defect, then parents become afraid of sending their children to the Duang Prateep Foundation for schooling because they believe the teachers will not try to help the children with such needs. After we asked our questions, the principal pointed out to us the best ways to communicate with the parents. Her advice was that we should not use brochures or pamphlets because not everyone in the community can read. Instead, the best way to spread news is through one of three ways: Television, radio, or the intercom system in Klong Toey.

We asked the teachers about the hygiene they teach their children and what they believe is the most effective way of teaching children and parents about lead and hygiene. All of the teachers responded by saying they teach their children about thorough hand washing. On a regular basis, the teachers also tell their students not to put their hands or the toys in their mouths. They also instruct them to brush their teeth frequently. When asked about the best methods on how to teach children and their parents about lead poisoning and hygiene, most teachers agreed that visual illustration is the best method. They stated that many of the people in the district cannot read or write (see Figure 12).

Figure 12: Verbally conducted survey

From all the data we gathered, it was seen that teachers at the Duang Prateep Foundation had a moderate understanding of lead, but they did not realize how relevant lead contamination was to their daily lives. While the teachers were aware that lead exposure could be a health risk, they did not understand the specific health threats dictated by lead poisoning. While some teachers understand lead more than others, there is little they can do about removing lead from their environment for reasons beyond their control. It is understood that the nursery is in some respects limited due to finances, hence a campaign should be developed that is practical and within the Foundation's budget. We found that hygiene practices at the nursery were emphasized as a daily activity within the school schedule. The goal is to teach the students good health habits that they may practice during childhood and carry into their future. The kindergarten teachers believe that it would be most effective if the parents are instructed as well on the dangers of lead. This will ensure safe monitoring of children and their hygiene habits in all their respective environments. They showed personal interest in an education program for the teachers themselves to better protect the children. In addition, many of the teachers believed that the best way to educate parents on lead and hygiene was through visual and audio means (learning through hearing). The administration at the nursery gave another viewpoint, however. They believe the best way to educate their teachers on lead is through a straightforward lecture with a clear example by picture demonstration. In terms of relationship with parents, we found that there was a strong relationship among parents and teachers. Finally, the teachers believed that the best way to teach children good hygiene practices is through a type of "playful learning". Our observations of the teachers and children confirmed what the teachers and administration told us in the interviews and surveys. This interactive education method that resembles a child's instinctive play presents multitudes of possibilities to communicate lead-safe practices with the young students.

Appendix B-10: Details on Interview with Doctor from Ramathibodi Hospital

Q: How prevalent is the issue of lead poisoning in Thailand?
A: Not prevalent enough; the government only focuses on oil with little concern for paint. The government only requires symbols on paint cans to encourage people to use low lead paint. There are guidelines concerning lead paint used for toys but the government has no control over those standards. A study was conducted on newborn children and the lead present in their body. It is better than it has been in the past but lead is still present in their bodies.
Q: How often do you test patients for lead poisoning?
A: There are two different types of symptoms that present in children, acute and chronic. There are very few cases of acute lead poisoning in the hospital. Lead poisoning takes time to show the symptoms. There are no set practices for testing blood for lead in Thailand.
Q: How do you diagnose lead poisoning, what are some of the worst cases you have seen in patients, especially children?
A: Anemia and seizures are common examples of symptoms as a result of lead poisoning, but doctors are not trained to relate them to lead poisoning. General blood testing is done by the hospital, but lead testing is not one of them. In the US, any region contaminated by lead would automatically warrant a blood test for lead. This is not true in Thailand.
Q: How many cases of lead poisoning do you see yearly?
A: It is not common to see lead poisoning in Bangkok. It is found more in the rural regions of Thailand. Approximately 4-5 years ago in Kanchanaburi, there was a large number of children infected in a village who showed symptoms of lead poisoning, such as anemia and seizures. They went to test the water in the canal and found high lead levels. It was found after testing that the source of lead was coming from mineral factories. The sources of lead in Bangkok only come from paint, toys, and furniture coatings. Rural areas are more exposed to lead due to inappropriate dumping of waste from factories.
Q: What do you think is important for the community to know about lead poisoning, especially what do you think is important for children to know?
A: They should know the effects and the health risks from lead paint or any other sources. They should know how to prevent lead poisoning because if they know only the effects, then they will be alarmed with no solution for how to protect themselves.
Q: Do you feel it is important to teach the community about lead poisoning? Can you suggest suitable media for teaching this information?
A: Direct communication or a seminar is the best method because people prefer the information presented to them directly. Also, work with the local leadership because the people are more likely to listen to them.
Q: Are you working to publicize this issue/would you like to raise more awareness about this issue?
A: I would like to raise awareness about this issue and spread the message to other communities.
Q: Can you explain the purpose of your study?
A: The purpose of this project is to raise awareness about lead that is present around children. Our goal was to fix all 400 nurseries that tested positive for lead. Publicizing the issue would put pressure on the government to act. Attempting to use direct communication with the government does usually work because they do not listen. After his findings were publicized, the government contacted him asking for the research documents so they could create a campaign to fix

nurseries. The process was found to be time consuming and costly, so they decided not to pursue the issue.

Q: Can you tell us more about the program you have to train doctors in lead poisoning prevention and diagnosis?

A: There is a curriculum in place for the doctors to learn about lead poisoning, but they only learn about it through lecture and reading. They do not receive any practical experience during medical school.

Q: Whose responsibility do you feel it is to protect, inform and educate the general public about this issue?

A: Generally it depends on the problem. Many different organizations should be responsible in Bangkok. Organizations such as universities, public health administrations, and the Environmental Ministry should be the ones responsible for fixing the problem. Politicians and people who have received higher education should work together to help the places that need the most attention.

Q: Where does this problem stand in terms of your priorities (most important, less important issue)?

A: Toys are limited to a lead level of no more than 90 ppm by law but the standard is not practical.

Q: Do you have any international support or assistance on this work?

A: I am not being supported by any international organization.

Q: Based on the work you have done, do you feel you are making progress in fighting this issue? For example, lead gasoline has been eliminated, do you think this is a possibility for paint and if so what sort of timeline do you expect?

A: The problem is fixable but it will be time-consuming. It is hard to monitor toy manufacturers because unlike oil companies, there are many toy businesses. In the paint industry, there is less of an understanding about people, so they will sell oil paint containing lead that can be used for both indoor and outdoor painting, which they are not supposed to do.

Appendix B-11: Details on Meeting with Bangkok Metropolitan Administration

Of the Bangkok Metropolitan Administration, three representatives were present at the meeting.

1. Mr. Jaroon Meethanataworn, Deputy Director of Social Development Department Bangkok Metropolitan Administration
2. Ms. Sukritta Suecharoen, Director Social Assistance and Social Safety Office
3. Ms. Rung Ganda, Social Worker of the Social Safety Office

The Duang Prateep Foundation was represented by multiple members of the Foundation and the project group.

4. Ms. Prateep Ungsongtham, Duang Prateep Foundation
5. Ms. Hong, Duang Prateep Foundation
6. Farrah Baara, Sean Gile, Robyn Kennedy, Jirana Kittisopidadit, Tossapol Panupattanapong, Daria Santoro, Alexandra Vresilovic, Teng-wei Wang

Because the content would be discussed in depth, this meeting was held in Thai so all representatives would understand the information. Therefore, the information was translated from Thai to English. After presenting our project, included background, methodology, conclusions and recommendations, there was a discussion as summed in the following points.

- It is complicated to pass laws and regulation on human rights issues, especially on prohibited lead-based paint. Within the BMA, there are several departments that are involved in the lead paint discussion.
- It is possible to educate the staff and teachers on a preventative plan immediately. Several seminars and conferences for the educators are held yearly, therefore they can include this topic in the agenda.
- The BMA will plan a meeting with stakeholders in the paint manufacturing industry. This meeting will aim to agree on allowable lead levels in paint produced and sold in Thailand.
- There were questions raised about the public's lack of awareness and which department in the BMA is responsible for this.
- The proper methods of lead-based paint removal were discussed.
- Blood lead level testing was discussed to be the only way to know the exact cases and districts that suffer from the lead contamination. Blood testing for lead levels had previously been considered by the BMA, but because of human rights and budget issues, the option has been disregarded.
- The BMA agreed that standards of lead-based paint removal were necessary.
- Dr. Adisak and Dr. Chanarong will be contacted by BMA for their specialties and more information on the background of the whole lead testing event.
- They ask for our group's recommendations and our research information. Our report will serve as a basis of reference for their future work concerning lead poisoning and prevention.

Appendix C-1: Policy Manual

This manual was translated into Thai for distribution. The manual in the original English text is below.

2012

Duang Prateep
Foundation

In Collaboration with
Chulalongkorn University
and Worcester
Polytechnic Institute

[BEST PRACTICES FOR LEAD POISONING PREVENTION IN URBAN BANGKOK COMMUNITIES]

Table of Contents

Introduction

In managing the transition from an agricultural to an industrial-based economy, both governmental agencies and communities often face difficulties in mitigating the unforeseen problems of development. These issues commonly result from a lack of knowledge concerning the operations and impacts of the new industries on the society and environment. Specifically, Bangkok's recent and rapid industrialization has created several challenges concerning environmental contamination. However, some of these problems are not recognized and are not effectively combated. One such pressing issue is lead-based paint contamination in Bangkok.

Due to the fact that lead-based paint is commonly used throughout Thailand, lead contamination is a widespread problem facing many communities. Prolonged exposure to lead contamination can lead to lead poisoning, a condition that results in a range of serious and expensive consequences. Currently, there is a lack of knowledge regarding the dangers of lead within the Thai general public. The Duang Prateep Foundation is actively working to increase the awareness level of the general public concerning lead poisoning prevention. However, educational measures alone are not sufficient to protect the public of Thailand from lead poisoning, as lead is still present within the environment. Therefore, the Foundation is calling for government involvement and collaboration to develop relevant policies and laws that will both prevent more lead from being introduced into the environment and rid the environment of the lead already present. It is the hope of the Foundation that these collaborative efforts will ultimately permanently eliminate lead contamination and its subsequent effects in Thailand.

This document has been drafted with the goal of informing Bangkok government of the critical nature of lead contamination. It details an overview of lead contamination within Thailand, particularly within Bangkok, and the health implications of lead poisoning. The specific situation at the Duang Prateep Foundation is also detailed as an example of an average case of lead contamination, and the positive actions taken to combat it.

Lead Contamination in Thailand

Due to recent and rapid industrialization, Thailand is facing challenges enforcing governmental regulations to control aspects of industry that are potentially harmful to the environment, allowing for several toxic substances to leach into the surroundings. Lead is one of the most prominent of these substances, and its addition into the environment has created a widespread occurrence of lead contamination. The convenient and inexpensive use of lead in industries and products has allowed the element to become a direct health hazard to many inhabitants, specifically those of poor communities.

The paint market internationally has used lead additives to improve the qualities of oil-based paint. Worldwide, cases of lead contamination have been tested with varying degrees of toxicity (UNEP, 2011). Oil-based paint is commonly used throughout the world due to its durability and low price (Oil vs Latex Paint). However, this type of paint often contains high concentrations of lead which can easily be spread into the environment. Because of the prevalence of lead-based paint in Bangkok, many Thai citizens, particularly children, are either at risk for or currently experiencing physical and mental health problems resulting from continuous exposure to lead contamination.

The Thai national paint manufacturing industry is currently loosely regulated in comparison to the more stringent standards of many other nations. The best standards recognized internationally set lead concentration levels in consumer paint to a maximum of 90 parts per

million. While the Thai government currently has a non-compulsory recommendation of 600 parts per million (Ministry of Industry, 2011), a large amount of paint available on the market does not meet these standards. A study conducted by Toxics Link on Thai paint manufacturers found that 41% of enamel samples exceeded the government standard (Kumar, 2009). Additionally, lead-based paint is cheaper to manufacture, therefore the market price of high lead level paint is lower. This increases the probability that lead-based paint with concentrations over 600 ppm is preferred in low-level markets over lead-free paints (UNEP, 2011).

In addition to lead regulations in the market, countries following the best practices concerning lead contamination have detailed proper lead decontamination practices during reconstruction and renovation. This policies target the construction contractor and the methods used to remove lead-based paint. As comprehensive recommendations, the set plans to remove lead are put forth by national governments and encouraged through various programs. Compared to the enforced best practices, Thailand's current standards do not encompass any removal regulations.

This entire lack of lead-based paint decontamination regulations has let the renovation industry develop without proper guidance. Prompted by the lack of regulations on removal, the majority of construction workers do not effectively remove lead-based paint. Through an assessment of Bangkok contractors, it was found that there is a basic knowledge of lead as a risk to human health within the industry workers. With a low level of awareness and a lack of instruction from the government, most contractors turn to the methods of paint removal as experienced through work in the construction field. The often ineffective methods used by contractors pose great risk to human health if the toxin is not fully removed from the occupant environment, or is further released into the environment through the improper removal methods. In concern for the public health, the construction contractors should be fully informed on the dangers of lead-based paint and instructed on safe removal practices.

Health Implications of Lead Poisoning

Lead poisoning is a serious medical condition that results from the intake and build-up of lead-based materials over time. The United States Center for Disease Control defines lead poisoning as blood lead levels greater than 10 micrograms of lead per deciliter of blood. This is also the level at which the CDC recommends public health action be taken (Center for Disease Control, 2011). However, recent studies are indicating that levels of lead even lower than 10µg/dL can negatively influence both the physical and intellectual development of children (Koller et. al., 2005).

According to the US Environmental Protection Agency, the three most common sources of lead poisoning are lead-based paint, particularly paint that is deteriorating, lead contaminated dust, and lead contaminated residential soil. Lead poisoning develops mainly through the ingestion and inhalation of lead particles from these sources. Lead particles enter the blood stream and accumulate to higher concentrations with increased exposure to the contaminated environment. Greater than 90% of the lead in the body accumulates in the bones. Lead in the bones can be released into the blood stream, and is carried throughout the body to other organ systems (Yale-New Heaven Teacher Institute, 2011).

In general, young children are at the highest risk for experiencing the extreme detrimental effects of lead poisoning. This is due to the difference in body mass ratio between children and adults; it takes a much smaller amount of lead for concentrations to reach toxic levels in children

than it would in a larger adult (Department of Health, 2011). Additionally, children have increased susceptibility due to their hygiene practices. When children play with toys painted with lead paint or in soil contaminated with lead, and then put their hands in their mouths without washing them, they unintentionally ingest lead. The combination of hand-to-mouth activities and playing close to the ground increases their susceptibility to lead ingestion (CDC, 2011). However, adults can also experience severe symptoms resulting from lead poisoning.

The toxicity of lead is well-documented, though children and adults experience different sets of symptoms. In children, the most sensitive target for lead poisoning is the nervous system. Exposure to lead can cause diverse neurologic or behavioral problems during their developmental years, such as inattentiveness, hyperactivity, and irritability. Other more severe problems include reading and learning difficulties, delayed growth, nerve damage and hearing loss (Eco-USA, 2011). In other organ systems, lead will interfere with the formation of red blood cells, kidney function, and synthesis of vitamin D. If not treated, these damages can be permanent (Yale-New Heaven Teacher Institute, 2011).

In adults, the most common symptom is high blood pressure, which may enhance strokes and heart attacks. High levels of lead in pregnant woman can be harmful to both the mother and fetus, causing an increased risk of complications during the pregnancy. These complications include shorter gestational period, irreversible brain or tissue damage to fetus, and miscarriage (Department of Health, 2011). A list of lead poisoning symptoms is provided in Table 1.

Table 1: Adverse Health Effects of Lead Exposure (Department of Health, 2009)

Neurological Effects	Peripheral neuropathy
	Fatigue/Irritability
	Impaired concentration
	Hearing loss
	Wrist/Foot drop
	Seizures
	Encephalopathy
Gastrointestinal Effects	Nausea
	Dypepsia
	Constipation
	Colic
	Lead line on gingival tissue
Reproductive Effects	Miscarriages/Stillbirths
	Reduced sperm count/motility
	Abnormal sperm
Heme Synthesis	Anemia
	Erythrocyte protoporphyrin elevation
Renal Effects	Chronic nephropathy with proximal tubular damage
	Hypertension

Other	Arthralgia
	Myalgia

Due to the fact that the symptoms are general, lead poisoning can be difficult to diagnose. As an additional complication in diagnosis, patients often don't present with symptoms until the extent of the poisoning reaches a dangerous level. As a result, treatment for lead poisoning can be complicated and expensive. Medical treatment involves chelation therapy with *ethylenediaminetetraacetic acid* (EDTA). EDTA is a chemical compound that acts by binding to the lead, allowing it to exit the body through the urine (Mayo Clinic, 2010). Without the assistance of EDTA, lead is unable to exit the body, and simply accumulates in the various tissues. Although EDTA treatments are effective, lead poisoning often causes permanent damage that the treatment cannot reverse (Mayo Clinic, 2010).

Case Study: Duang Prateep Foundation Nursery

In 2007 the Child Safety Promotion and Injury Prevention Research Center conducted a lead testing project within the districts of Bangkok, including Klong Toey. Numerous samples were taken from multiple different buildings within and around the Klong Toey area. The center detected dangerously high levels of lead paint in the walls of a Klong Toey nursery run by the Duang Prateep Foundation. Within the nursery, the wall paint was the only source of lead contamination, with levels exceeding the acceptable health standards of 90 parts per million (ppm). Although the center informed the Foundation of the contamination problem, they did not provide any action or instructions for how the nursery should eliminate the contamination. Therefore, in order to mitigate the problem, the Duang Prateep Foundation hired a private contractor to remove the paint in the building.

The nursery was retested in 2009 by the Provincial Coordinate Center for Civil Society Organization. Surprisingly, the lead level increased by a significant amount; the new concentration was found to be 2,582 ppm. Due in part to these findings, *The Daily News* published an article on February 11, 2010 that discussed the general health risks of lead contamination posed to the students of these nurseries. In addition to the Duang Prateep Foundation, nine other nurseries were mentioned in the same article, demonstrating the widespread nature of the problem.

This unexpected increase in lead levels caused the Duang Prateep Foundation to review and modify its initial 2007 plan of action. The Foundation understood that prompt remediation was critical because lead poisoning poses both physical and mental health risks to both the teachers and the children who attend the school. In addition, they understood that their situation was not an isolated case, but rather just one small example of a problem present within many buildings and residences in Bangkok. The Foundation thus collaborated with a team composed of students from Chulalongkorn University and Worcester Polytechnic Institute to bring awareness to this issue.

Leaders at the Duang Prateep Foundation believe that because they did not receive clear instructions on how to manage the contamination after the government testing, their situation worsened despite their best efforts to remediate. The student teams thus worked with the Foundation to assess the situation, identify the factors contributing to the problem, and propose appropriate preventative means to eliminate lead contamination and lead poisoning from lead-based paint both in the nursery and throughout Bangkok.

With their efforts, the Duang Prateep Foundation acts as a leader to communicate proper lead contamination remediation practices and lead poisoning prevention habits to all stakeholders in Thailand. In the Klong Toey district, the Foundation is raising awareness through various methods. The Foundation plans to reach out to the general public through public announcements over the Klong Toey intercom system, by advertising the use of lead-free paint with posters in the communities and by providing the community with public seminars and pamphlets regarding prevention practices. To supplement this information, the Duang Prateep Foundation has compiled a list of professional resources for contractors to help communicate proper standards for lead-based paint removal and plans to hold a seminar to provide invested contractors with information pertaining to proper practices and health precautions. Moreover, the Duang Prateep Foundation is actively working to prevent lead poisoning in children at their nursery, in surrounding nurseries and in the community by developing educational games, skits, and videos designed to promote proper hygiene practices. The Foundation now hopes to bring their campaign to public and government attention in order to combat this issue on a larger scale and assist other communities in similar situations, with the ultimate goal of eliminating the problem of lead contamination in Thailand entirely.

Conclusion

Although the Duang Prateep Foundation is raising awareness in communities in Thailand, the problem cannot be remediated with their work alone. In conjunction with awareness campaign efforts, public policy has been implemented in other nations that are succeeding in removing lead-based products to protect citizens. Lead contamination problems can only worsen with time. In the interest of public health it is critical for appropriate regulations on both lead levels in paint and lead removal practices to be developed and enforced. By preventing lead contamination and then regulating the remediation process, the threat of lead poisoning in Thailand can be thoroughly addressed and the costly efforts to reduce these health effects will be significantly reduced. Through thorough standardization, laws and regulations the dangers of lead contamination in Thailand will be significantly decreased, and hopefully permanently eliminated.

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Appendix C-2: Intercom Script

This Appendix was translated in Thai for the use within Klong Toey. This script is intended for use as an awareness announcement during the morning and evening news over the intercom system in Klong Toey:

"The following is a message brought to you on behalf of the Duang Prateep Foundation. This announcement is especially important if you have children under the age of seven.

Leaders at the Duang Prateep Foundation would like to make the community aware of a growing concern in Thailand. A large number of household paints contain lead, a substance that is toxic in high concentrations. Though the dangers of lead are concerning, the citizens of Klong Toey should not panic because the Duang Prateep Foundation will provide measures to prevent sickness.

If the paints chip off the wall, the dust can spread lead into the environment, and it can be easily inhaled or ingested. Over time, exposure to these lead particles can lead to lead poisoning. This is especially true for small children aged 6 and under. Symptoms of lead poisoning include irritability, weight loss, fatigue, blood problem, bone problems, and kidney problems, but most seriously developmental problems.

Lead can interfere with your child's health and education, but there are some simple ways to prevent lead poisoning. First, you can purchase lead-free paint when remodeling home or business. If you think you may already have lead paint, you can hire a certified contractor to remove it.

If you notice chipping paint, instruct your children to avoid it. Also encourage them to practice good hygiene, such as washing their hands regularly.

Lead exposure DOES NOT necessarily cause lead poisoning. You can take proactive measures to protect yourself and your family from lead. For more information, or if you are concerned your family may be at risk for lead poisoning, please contact the Duang Prateep Foundation. The foundation will be hosting an informational seminar open to the public to educate about lead on [date/time]. "

Appendix C-3: Seminar for Community Members, Teachers, and Parents

This outline was translated in Thai for applicative purposes.
Outline Lead Seminar for Parents:

We propose that the Duang Prateep Foundation host an informational seminar to the general public and parents that are primarily illiterate. We believe the best way to present the material in the seminar is through a lecture and presentation that avoids the use of words and focuses on visual pictures. We also suggest that a member of the Duang Prateep Foundation knowledgeable on the issue of lead contamination from lead-based paint present the seminar. The established credible services and efforts of the Duang Prateep Foundation within the Klong Toey community will ensure the participation of members and parents in the seminars.

Introduction

- Introduction of speaker
- State that the subject of this seminar is about lead contamination through lead-based paint
- Inform the audience that effective poisoning prevention practices will be provided

Topic 1 – Lead in Everyday Life

- Lead is a naturally occurring metallic grey element of the earth
- Today it is prevalent in the daily lives of citizens because it is commonly found in many industrial processes and products
- It is found in gasoline, pipes, soil, water, and paint
- Easy to come in contact with lead when it is not managed, but difficult to identify visually in common household items
- When mixed in paint, it is not identifiable visually, can only be confirmed by chemical testing or an evaluation of the paint content
- Paint cans can be scanned and checked for the presence of certain symbols that indicate the absence of lead in the content

Topic 2– Lead in Paint

- There are two different types of paint commonly used in industry (oil and water based paint being the most common). Many oil-based paints contain high levels of lead
- An identifying mark on the paint can will say if the paint is lead-safe
- Purchase paint with authorized symbols that indicate it is lead-free

Topic 3 - Health threats of lead-based paint

- Peeling paint generates dust and chips in the surrounding of residents

- Independent and unregulated removal attempts or disturbance of paint generates a significant amount of paint dust and chips into the environment
- Paint chips and dust accumulate in various areas of the house which act as vectors by which lead contamination is further spread

Topic 4– Lead poisoning occurs by two methods

Inhalation

- Inhalation of dust containing lead particles

Ingestion

- Ingestion of paint chips that falls on food
- Putting your hands in your mouth after touching lead paint
- Eating paint chips (more common in children)

Topic 5– Health Effects

- Once in your body, lead collects in the bones and will be released periodically into the blood stream
- Effects are different in adults and children

    - In adults the symptoms are fatigue/irritability, seizures, nausea, miscarriages, anemia, death
    - There are even more symptoms in children because they are still developing and are more vulnerable to lead
    - Takes a smaller amount of lead to cause lead poisoning in children
    - Additional symptoms for children are mental defects, slow learning ability, coma, and possibly death of untreated

Topic 6– Prevention Method

- Do not try to remove the paint yourself
- Keep yourself and children away from the peeling sites on the wall
- Call certified contractors to remove paint properly (removal process is lengthy)
- Until certified help is available it is important to cover the deteriorated paint with vinyl coverings or boards to prevent further dispersal of paint dust and chips

Topic 7– Hygiene Practices

- Make sure you and your children wash your hands frequently
- Clean your house with a wet mop to clean the dust off the floor. Do not use a dry broom alone as this may further the dispersal of dust particles
- Clean the dust off of household furniture using a wet rag to prevent further dispersal of the contaminated dust
- Clean your children's toys frequently
- Test your child for blood lead levels at your nearest hospital facility if you suspect he/she is lead poisoned

End

- Allow the audience to ask questions and comment

Appendix C-4: Seminar for Contractors

This outline was translated in Thai for applicative purposes.
Outline Lead Seminar for Parents:

We propose that the Duang Prateep Foundation encourage contractors to work with the Lead Fighting Team to learn lead-safe renovation methods. The seminar sets out to establish the best containment practices necessary to renovate sites containing lead-based paint. It is important to inform the renovators of these best practices in order to protect the workers and the community at large. Contractors that are not mindful of lead safety precautions threaten the safety of surrounding dwellers.

Introduction

- Introduction of speaker
- State that the subject of this seminar is about lead-safe renovation practices
- Inform the audience that implementation of these lead-safe practices will ensure the health and safety of workers and the community at large

Topic 1 – Lead in Everyday Life

- Lead is a naturally occurring metallic grey element of the earth
- Today it is prevalent in the daily lives of citizens because it is commonly found in many industrial processes and products
- It is found in gasoline, pipes, soil, water, and paint
- Easy to come in contact with lead when it is not managed, but difficult to identify visually in common household items
- When mixed in paint, it is not identifiable visually, can only be confirmed by chemical testing or an evaluation of the paint content

Topic 2– Lead in Paint

- There are two different types of paint commonly used in industry (oil and water based paint being the most common). Many oil-based paints contain high levels of lead
- Paint cans can be scanned and checked for the presence of certain symbols that indicate the absence of lead in the content
- Always purchase paints with authorized symbols that indicate it is lead-free
- Together these precautions will ensure that lead-based paint is permanently eliminated from future household and facility surfaces

Topic 3 - Health threats of lead-based paint

- Peeling paint generates dust and chips in the surrounding of residents
- Independent and unregulated removal attempts or disturbance of paint generates a significant amount of paint dust and chips into the environment
- Paint chips and dust accumulate in various areas of the house which act as vectors by which lead contamination is further spread
- It is crucial that contractors practice lead-safe removal practices in order to prevent further accumulation of paint dust and chips in the direct environment of citizens

Topic 4– Lead poisoning occurs by two methods

Inhalation

- Inhalation of dust containing lead particles

Ingestion

- Ingestion of paint chips that falls on food
- Putting your hands in your mouth after touching lead paint
- Eating paint chips (more common in children)

Topic 5– Health Effects

- Once in your body, lead collects in the bones and will be released periodically into the blood stream
- Effects are different in adults and children
  - In adults the symptoms are fatigue/irritability, seizures, nausea, miscarriages, anemia, death
  - There are even more symptoms in children because they are still developing and are more vulnerable to lead
  - Takes a smaller amount of lead to cause lead poisoning in children
  - Additional symptoms for children are mental defects, slow learning ability, coma, and possibly death if untreated

Topic 6– Containment Practices

1. First the renovators must determine the presence of lead-based paint at the construction site. The test must be completed in collaboration with an authorized laboratory. If the test is positive then the contractors must proceed to implement lead-safe containment pre-cautions.
2. The site of construction must be established. This is necessary to prevent the haphazard dispersal of construction debris into the daily lives surrounding occupants. It is important to consult certified personnel about proper containment procedures for various household sectors- windows, doors, bedrooms etc...
   - Indoor- construction site encompasses all areas extending six square feet from the site
   - Outdoor- construction site encompasses all areas extending ten square feet from the site
   - All water sewage must be covered and protected from construction debris and dust. One common method is the placement of sand bags over water drains and around the construction parameters to protect against leakage of uncontained water residue.
3. Workers must wear protective gear that covers their body from head to toe- hat, coveralls, respirator, and shoe covers
   - Respirator is worn at all times and is necessarily the last gear to be removed at the end of every day to prevent poisoning through inhalation
   - Clothes must be contained in durable plastic bags at the end of every day
   - Construction clothes must be washed separate from the worker's daily attire
4. Method of removal must not generate unmanageable debris

- Open flame burning and heat guns that are over 1,100 degrees Fahrenheit generate fumes that require ventilation of construction sites.
- Sanding, grinding, abrasive blasting and sand blasting are improper methods of removal. Use of power tools that lack a HEPA vacuum attachment are also forbidden because of the broad generated dust and debris.
- Allowed methods will be discussed later on

5. Leave the work site clean at the end of every day
    - Paint chips and debris must always be collected into plastic bags using a wet cloth. Plastic coverings can also be misted and folded with the collected debris on the inside surface.
    - HEPA vacuums are also used to filtrate the air of the lead contaminant
6. Dispose the collected debris at your local authorized hazardous waste landfill
7. Verify the work area is clean and void of lead.
    - A visual test is first performed that scans the rooms for the presence of paint chips. Counter tops, window sills, and floors are then wiped and moped. The samples are verified against a cleaning card.
    - Verification can also be done by testing dust sample and paint sample for their lead content.

Topic 7– Removal Methods

- Dry power sanding processes that are equipped with HEPA vacuums are the most effective method of removing lead-based paint because they do not generate airborne debris. However, the machine must be handled by certified personnel and it is not commonly found in Thailand. As a result this method of removal is neither feasible nor affordable by local Thai contractors
- Chemical strippers free of methylene chloride effectively remove thick lead-based paint. However, contractors must be careful to properly manage the dangerous product and dispose of the generated sticky residue. In addition, the product is outside of the affordable budget range of most local Thai contractors.
- Wet sanding and scraping is the commonly used method of paint removal practiced in Thailand. Such procedures are still viable in removing lead-based paint however contractors must contain all the generated debris. Power washing of the wall surfaces is not allowed. Instead delineated surfaces can be misted and washed in steps. Each section of the wall should have plastic bag attachment below it that collects all the chipped paint.

End

- Allow the audience to ask questions and make comments

Appendix C-5: Resource Document for Contractors

This appendix was translated into Thai for applicative purposes.
The following is a list of helpful and knowledgeable contacts for Thai contractors to refer to:

No 34 Lock 6, Art Narong Road, Klong Toey Bangkok 10110 Thailand
Telephone:+66(0)267 14045-8, 249 3553, 249 4880 Fax:+66(0)2249 5254, 249 9500
e-mail : dpffound@ksc.th.com , http://www.dpf.or.th

Faculty of Medicine Ramathibodi Hospital, Mahidol University
Rama 6 Road, Bangkok, Thailand 10400
telephone : +66(0)2354-7308 website://med.mahidol.ac.th

Thai Industrial Standards Institute
75/42 Rama 6 Street, Ratchathewi, Bangkok 10400, THAILAND
email: thaistan@tisi.go.th

Intertek Testing Service (Thailand) Ltd.
5/1 Phahon Yothin 28, Phahon Yothin Road,
Lat Yao, Chatuchak, Bangkok 10900 THAILAND
Tel. +662 939 0661, 930 6554 Fax. +662 939 0669

The Engineering Institute of Thialand Under H.M. The King's Patronage
487 Rarmkhamhaeng 39 Wangthonglang Bangkok 10310
Tel. -2319-2410-3 Fax. 0-2319-2710-11
E-mail: eit@eit.or.th

Appendix C-6: Example Awareness Posters

Figure 14: The word "Danger" repeats across the yellow caution strips, and written in the red paint is the word "Lead"

Figure 13: In the center the words "No Added Lead" are written in Thai

Appendix C-7: Pamphlet for Community Members

Copies of this pamphlet are presented both in English, for the purpose of this report, and in Thai, as will be distributed to the public of Thailand.

Figure 14: Back of Pamphlet in English

Effect of Lead Poisoning

Lead poisoning acts differently in adults and children due to differences in their immune system. High concentration of lead in the body may destroy one's nervous, circulatory, and digestive system. Children have a weaker immune system and hence lead poisoning effects on children is more severe. High levels of lead in infants and children may inhibit proper brain development and even cause death.

Lead poisoning is either acute or long term. The acute effects are dizziness, headache, blurry vision and loss of energy. Whereas long term effects are organs failure, brain damage, kidney and liver problems, as well as developed blood pressure.

How Lead Enters the Body:

Lead may enter the body through the mouth (ingestion) or through the nose (inhalation). Once it enters the body its stores itself in the bones.

- Ingestion: Eating foods contaminated with paint flakes or dust, using utensils contaminated with lead, as well as placing one's contaminated hands in one's mouth.

- Inhalation: breathing contaminated lead dust or fumes.

Prevention of Lead Poisoning

Parents should conduct good hygiene practices especially if they have children less than six years of age. Teaching children to wash their hands before eating can prevent ingestion of lead through hand to mouth activity. House floors, furniture, and toys should be washed daily using a wet rag and mop. A clean home prevents accumulation of lead dust which may potentially cause poisoning. Children and infants must vacate homes undergoing lead contaminated renovations. Contractors and workers must wear protective gear including repiratory mask, gloves, and coveralls. Lastly, blood test should be perform on annual basis in hospitals to check the lead levels in blood.

Figure 15: Front of Pamphlet in English

Figure 16: Back of Pamphlet in Thai

Figure 17: Front of Pamphlet in Thai