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The Importance of Unstructured and Structured Observations Methodology as Applied in Maternity Wards in Two Cambodian Hospitals

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By

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Bachelors of Science

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2015

Thesis Committee Chair: Fauzia Aman Malik, M.Sc.

An abstract of

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Abstract

The Importance of Unstructured and Structured Observations Methodology as Applied in Maternity Wards in Two Cambodian Hospitals

By Amanda Dam

Background: Over the past 20 years, maternal and neonatal/infant mortality rates in Cambodia have steadily improved but continue to be among the highest throughout Southeast Asia with 161 maternal deaths/100,000 live births, 15 neonatal deaths/1,000 live births, and 25 infant deaths/1,000 live births. These deaths largely result from preventable infections. The work discussed in this thesis was part of a larger pilot study investigating the causes and routes of transmission of specific healthcare-acquired-infections in maternity wards of two public hospitals in Phnom Penh, Cambodia.

Methods: Researchers conducted unstructured and structured observations of morning rounds, routine cleaning, and post-delivery procedures for one week each in the maternity wards of two hospitals. Researchers used notes from unstructured observations to develop an understanding of typical behaviors in settings of interest and to prepare charts for structured observations.

Results: Healthcare staff were typically not observed wearing gloves during patient interactions. Researchers found that this, as well as other inconsistencies in routine cleaning procedures, were related to the gaps in proper infection-prevention-and-control (IPC) training. In both hospitals, patients and their families in post-delivery rooms were responsible for bringing their own water, food, and hygiene materials, but observations found that many did not always bring hygiene materials with them. Lastly, structured observations found that cleaning and waste disposal procedures in Hospital B had several "poor" IPC practices, but generally adhered to "good" IPC practices in the delivery rooms.

Conclusion: This study has found that existing IPC training procedures need to be strengthened among healthcare workers of both hospitals. Additionally, water-and-sanitation-hygiene educational materials need to be taught or distributed to patients and their families to minimize possible spread of healthcare-acquired infections. Furthermore, water-and-sanitation-hygiene infrastructure needs to be improved in both hospitals to promote better personal hygiene and to provide easy access to safe and clean water for patients, their families, and healthcare staff.

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Definition of Terms

HAIs: Healthcare-associated infections

IPC: Infection prevention and control

MDG: Millennium Development Goal

WASH: Water and sanitation hygiene

WHO: The World Health Organization

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Chapter 1: Background and Literature Review

Background

Contrary to popular belief, the fall of the Khmer Rouge regime did not simply end in 1979. Although the genocidal regime no longer ruled the country of Cambodia after 1979, the Khmer Rouge leaders continued to wage guerilla war in Cambodia against the Royal Government of Cambodia until a majority surrender in 1998. In 1999, what remained of the Khmer Rouge collapsed after remaining leaders "had defected to the Royal Government of Cambodia, been arrested, or had died" (Leitsinger, 2015). As a result of the Khmer Rouge, up to 30% of the population of Cambodia were killed. Scores of missing bodies and torture facilities that housed slain civilians are not accounted for in that 30%. Housing, the economic system, education systems, and health infrastructure in Cambodia suffered immense losses. Specifically, the destruction of the health infrastructure of Cambodia contributed to the rise in communicable diseases, the increase in maternal and neonatal mortality, and the lack of skilled healthcare workers in various healthcare facilities throughout Cambodia ("Cambodia Refugee Crisis: History," n.d.; De Walque, 2005). These specific aspects of health infrastructure continue to directly contribute to the morbidity and mortality among Cambodians in the present day, especially among babies and young adults as approximately half of the population of Cambodia is under 25 years old ("The World Factbook," 2017). Particularly among mothers and neonates, maternal and neonatal morbidity and mortality continue to be a problem that Cambodia experiences as many of these illnesses and deaths are preventable.

In order to examine the causes of maternal, neonatal, and infant morbidity and mortality, a research team from Emory University conducted a two-part pilot study, funded by the General Electric Foundation, in two public Cambodian hospitals. In the first part of the

study, one researcher performed unstructured and structured observations over the span of three weeks to gain clarifications on the infection prevention and control (IPC) practices and water and sanitation hygiene (WASH) behaviors among healthcare staff and patients in hospital maternity wards. In the second part of the study, based on findings from structured observations, researchers carried out microbial testing and environmental sampling over an eight-week span between both hospitals. Environmental sampling consisted of water collection from multiple sources of water use in the hospitals as well as collection of hand rinses from specific healthcare staff and equipment rinses in maternity wards at each hospital. Microbial testing consisted of swabbing surfaces and objects in specific areas within maternity wards using swabs soaked in neutralizing buffer. Researchers conducted environmental sampling and microbial testing twice per week at each hospital to examine bacterial contamination of surfaces, objects, equipment, and hands of healthcare staff at different times of the day. Although both parts of the study were integral in investigating the transmission pathways of healthcare-associated infections among healthcare staff, mothers, and neonates, the first part of the study involving unstructured and structured methodologies will be the focus of this thesis. Analysis of data in this thesis is a sub-set of the data from the overall study.

The decision to look at the use of unstructured and structured observation methodology provides an organized way in which behaviors and practices implemented in the settings of interest correlate with actual training and match the accuracy of people's statements about their behaviors and practices. The first part of the study examined the biological pathways and highlighted the importance of conducting unstructured and structured observations in maternity wards of two Cambodian hospitals to identify mechanisms of possible healthcare-associated infections of *Klebsiella pneumoniae, Staph aureus,* and any strain of *Escherischia coli*. It also identified gaps in infection prevention and

control practices and water and sanitation hygiene behavior among hospital staff. The first phase of the study sought to answer the question: What objects, surfaces, or individuals are mothers and neonates being exposed to that may be sources of bacterial contamination to lead to maternal and neonatal morbidity and mortality? Furthermore, this thesis seeks to answer the questions: What is the importance of conducting unstructured and structured observation methodologies? How is it helpful in understanding if behaviors and practices implemented correlate with hospital staffs' training?

Literature Review

Maternal and Infant Mortality

After the end of the Khmer Rouge, less than 50 doctors remained in Cambodia out of more than 600 doctors who were once present before the regime's mass executions of educated individuals (Adams & Al Sindhi, 2014). This significant reduction in the availability of doctors inevitably led to a significant reduction in the quality and availability of healthcare throughout Cambodia, particularly among women, as they had a larger population demographic compared to men, who were more likely to be killed during the Khmer Rouge regime (De Walque, 2005). Maternal and neonatal mortality were of particular significance for a relatively young and fledgling population struggling to recover from the country's losses post Khmer Rouge. Before the Khmer Rouge regime completely collapsed, maternal mortality rates were 690/100,000 live births in 1990 (Liljestrand & Sambath, 2012). In 2000, a year after the dissolution of the Khmer Rouge, maternal mortality rates decreased to 432/100,000 live births; and in 2010, they decreased even more to 206/100,000 live births (Liljestrand & Sambath, 2012). However, compared to the ten countries that are a part of the Association of Southeast Asian Nations (ASEAN), "Cambodia [is] among seven countries with the highest maternal mortality ratios," ranked second to Laos (Acuin et al., 2011, p.156).

Many mothers continue to suffer from preventable causes of death during their deliveries, such as hemorrhages, "pre-eclampsia/eclampsia, sepsis, obstructed labor, and uterine rupture, accounting for roughly [88%] of all maternal deaths" (Adams & Al Sindhi, 2014, p.10). Other causes of death that are not as well documented as the aforementioned major causes include anemia, malnutrition, HIV/AIDS, and direct links to infectious disease (Adams & Al Sindhi, 2014).

Additionally, despite declining rates of neonatal and infant mortality rates in Cambodia from 2000-2010, they still remain among the highest out of ASEAN countries (Acuin et al., 2011; Hong & Dararith, 2013). It is important to define that neonates are babies aged 0-30 days old, and infants are defined as 0-365 days old. Neonatal mortality rates in Cambodia were largely unknown and unreported during the time of the Khmer Rouge, but rates in 2000 were recorded as being 37/1,000 live births, shortly after the complete disbandment of the Khmer Rouge regime (National Institute of Statistics/Cambodia, Directorate General for Health/Cambodia, & ICF Macro, 2011). Furthermore, in 2010, neonatal mortality rates decreased to 27/1,000 live births (National Institute of Statistics/Cambodia et al., 2011). Infant mortality rates were 129/1,000 live births in 1977 during the era of the Khmer Rouge Regime (National Institute of Statistics/Cambodia et al., 2011). In 2000, infant mortality rates decreased to 95/1,000 live births; and in 2010, infant mortality rates decreased even more to 45/1,000 live births (National Institute of Statistics/Cambodia et al., 2011). A variety of factors contributed towards the reduction in neonatal and infant mortality in Cambodia, including socioeconomic statuses, educational level of mothers, and birth order of children (National Institute of Statistics/Cambodia et al., 2011). Additionally, malnutrition of mothers and babies, poor water and sanitation hygiene practices from families and healthcare staff, and poor infection prevention and control practices among healthcare staff in hospitals where babies are born all contribute to neonatal

and infant mortality (Bazzano et al., 2015; Department of Planning and Health Information et al., 2002). Most factors that contribute to the morbidity and mortality of neonates and infants in Cambodia are preventable with the proper knowledge among mothers and healthcare staff, proper training among healthcare staff, and improvement in healthcare facilities.

In order to further examine the pathways of transmission of healthcare-associated infections that may contribute to maternal, neonatal, and infant mortality, water and sanitation hygiene (WASH) behaviors and infection prevention and control (IPC) practices in Cambodian hospitals, healthcare access in Cambodia, and the methodology of unstructured and structured observational studies must be considered. Water and sanitation hygiene involves the correlation between human health and proper waste disposal, the presence of toilets and latrines, hand-washing behaviors, safe water sources and storage, as well as how people affect and interact with the aforementioned factors. Infection prevention and control practices refer to behaviors and procedures conducted in healthcare settings to dispose of and properly store waste and medical equipment, properly sanitize medical equipment, and take the necessary precautions to prevent the spread of infections in a healthcare setting among other healthcare staff members and patients. WASH behaviors and IPC practices of healthcare staff, patients and their families, and the overall environment are critical factors that can directly contribute to maternal, neonatal, and infant mortality. Additionally, healthcare access is more prevalent in urban areas compared to rural areas of Cambodia, which contributes to the wide disparity in maternal, neonatal, and infant mortality rates observed within these two settings. Unstructured and structured observational methods have proven to be effective techniques for accessing adherence to IPC and WASH practices. They have also been useful in observing unique adverse events that cannot be captured in microbial sampling and environmental testing.

WASH Behaviors and IPC Practices in Cambodian Hospitals

A qualitative study conducted by Bazzano et al demonstrated the little attention that WASH practices are given in the context of delivery and postpartum care in a healthcare facility setting (Bazzano et al., 2015). In addition to other studies, it has highlighted the gaps that exist in the optimal practice of infection prevention and control methods. It has also highlighted how these gaps stem directly from the absence of supportive resources and staff to assist midwives and birth attendants in maternal care and deliveries (Bazzano et al., 2015). In most cases, government health facilities lacked year-round availability to clean water sources. The toilets were reported to be either non-functioning or inaccessible to healthcare staff and patients with limited mobility, such as pregnant mothers. Other challenges within the facilities included poor medical waste disposal, poor hand hygiene practices, and lack of support for menstrual hygiene management within the restrooms (WaterAid, 2015).

Access to clean water sources, sanitation, and hygiene are critical to infection prevention and control and for promoting improved health outcomes of patients in healthcare facilities. Patients who are seeking care in these facilities tend to be more susceptible to infections, especially mothers and their newborns, making the maintenance and having sterile and clean environments imperative for effective treatment. There are strong and established links between maternal and neonatal mortality and poor sanitation and hygiene practices, especially in healthcare facilities (Velleman et al., 2014). In 2008, The Health Impact Evaluation Consortium Survey assessed 447 facilities and found that overall, 67% of health centers had access to an improved water source compared to 51% in rural areas. This survey utilized indicators that the WHO minimum standards for water access considered inadequate, meaning the WASH disparities in healthcare facilities are greater than they appear (WaterAid, 2015). Understanding how Cambodians access health care is essential in order to

gain insight into why and how certain WASH and IPC practices are and are not practiced as well as what barriers exist for Cambodians to prevent them from accessing safe healthcare.

Healthcare Access in Cambodia

The major causes of maternal mortality in Cambodia are abortion-related complications, obstructed labor, hemorrhages, eclampsia, sepsis, and various infections (Matsuoka et al., 2010). These causes are most apparent in rural communities where there are barriers to women's use of health facilities. These barriers include high monetary costs, long distance, poor road conditions, lack of transportation, poor quality of care, lack of knowledge in emergency situations, socio-cultural norms, psychological well-being during the perinatal period, and the severe resource constraints of maternal healthcare facilities (Matsuoka et al., 2010). Government-sponsored health facilities usually do not have payment plans that are affordable to rural Cambodians, only accepting cash payments upfront. Because of the lack of access to affordable treatment, the use of non-qualified health service providers has become more prominent to meet the health care and delivery needs for women. Although the payment option is more flexible, the use of non-qualified health service providers exposes women to higher risks of complications during labor (Matsuoka et al., 2010). Additionally, a common cited reason for not utilizing government maternal services is poor geographic access to healthcare facilities.

Many of these barriers are interconnected. For example, the low socioeconomic status of rural inhabitants limits the funds they have available to cover delivery costs. Many of these rural inhabitants also have misconceptions that governmental health facility fees are much higher than they actually are, which then leads to the increased utilization of private healthcare workers who charge much higher prices. In addition, for a rural family, the costs of caring for a pregnant woman over time in combination with what the woman and her family members perceive as inconveniences during that time are associated with living in an

area with poor geographic access to maternal health facilities. Rural Cambodians are twice as likely to have poor access in comparison to urban Cambodians (Matsuoka et al., 2010). However, in recent years, there have been concerted efforts to address these inequities through the expansion of fee exemptions and health equity funds, and implementing voucher programs and community-based health insurance (Dingle et al., 2013). Furthermore, in order to address the issue of short-staffed maternal health facilities and under-qualified healthcare workers, Cambodia has begun implementing policies aimed at training midwives through midwifery financial incentive programs and by banning home deliveries carried out by traditional midwives (Dingle et al., 2013).

The positive outcomes of these efforts are noticeable through the remarkable reduction in maternal mortality rates collected by the Cambodian Demographic Health Surveys Program. The utilization of maternal healthcare facilities for deliveries have increased from 11% in 2000 to 69% in 2011, with skilled birth attendants being present at 71% of all deliveries (Liljestrand & Sambath, 2012). As of 2012, health equity funds cover 58 out of 77 operational districts (Liljestrand & Sambath, 2012). The implemented voucher program and no-cost health care provided to Cambodians of lower socioeconomic status has made antenatal care much more widely available and has guaranteed free maternity care for pregnant women in government health centers. Antenatal care now covers over 89% of all pregnant women, which is a significant increase from 38% in 2000 (Liljestrand & Sambath, 2012).

According to the WHO, there are only 7.9 midwives per 10,000 people in Cambodia, in comparison to the rest of the Southeast Asia region, which has an average of 15.3 midwives per 10,000 people (“Cambodia Neonatal and Child Health Country Profile,” n.d.). This disparity is even greater between urban and rural areas of Cambodia, and greatly affects its maternal and neonatal mortality rates because four in five Cambodians live in rural areas,

with only 21% living in urban areas ("Cambodian Demographic and Health Survey," 2010). Of the expectant mothers living in urban areas such as Phnom Penh, 84% have access to healthcare facilities, whereas 20% of expectant mothers from the more rural regions, such as Mondol Kiri and Rotanak Kiri (Matsuoka et al., 2010).

The Methodology of Unstructured and Structured Observational Studies

Unstructured observations are a type of freelance method employed in order to note behaviors, practices, and general observations of an area, situation, or process (Holly et al., 2002). They are used to help develop a general idea of how the area, situation, or process typically operates. On the other hand, structured observations are a more organized approach to note behaviors, practices, and general observations of an area, situation, or process. Structured observations involve using a pre-created table, chart, or list designed specifically for looking at particular aspects of behaviors, practices, and general observations after the completion of conducting unstructured observations to produce the aforementioned table, chart, or list (Holly et al., 2002).

Varieties of WASH studies have employed unstructured and structured observation methodology. For example, in a 2011 study conducted by Hancart-Petitet et al in Cambodian healthcare settings, structured observations were helpful to use in observing risky healthcare practices that may directly transmit HAIs to healthcare staff as well as mothers and neonates. Healthcare practices observed in some healthcare settings found that occasionally, healthcare staff diluted cleaning products and still used expired cleaning products in order to save money on purchasing extra supplies (Hancart-Petitet et al., 2011). These diluted and expired cleaning products may not be as effective at eliminating bacteria and pathogens on contaminated surfaces. Additionally, the research team in Hancart-Petitet et al's study stated that they "never observed systematic and complete washing/cleaning as recommended by the Protocol developed by the Department of Infection Control" (Hancart-Petitet et al., 2011,

p.3). In another example in a study conducted in rural Bangladesh, structured observations conducted over a 5-hour period yielded results that suggested that washing hands before food preparation is an important practice to prevent the occurrence of childhood diarrhea. Simply washing hands using only water can contribute towards the reduction in the occurrence of childhood diarrhea (Luby et al., 2011). Considering cultural practices, researchers conducted structured observations between 9 am-2 pm when most Bangladeshis in the area where research was conducted prepare food and will practice hygienic behaviors (Luby et al., 2011). Furthermore, researchers used a pretested instrument to record specific behaviors of all household residents regarding handwashing times and behaviors (Luby et al., 2011). Researchers in the study also noted common handwashing behavior. Data from structured observations were subsequently used in combination with a cross-sectional survey and 24-month long monthly surveillance data collection to provide a more robust picture of handwashing behaviors and practices as they relate to childhood diarrhea in rural Bangladesh.

As with any type of methodology, there are strengths, weaknesses, and challenges associated with unstructured and structured observational studies. As described in Carthey's paper, he explains how "the structure and culture of healthcare [organizations behave] as a barrier to effective teamwork" and that structured observation methodology would have been useful to employ to observe these dynamics (Carthey, 2003, p. ii13). However, because of the unspoken but established culture of not questioning superiors in healthcare settings, more adverse events occurred that could have been prevented had healthcare personnel with different ideas to their superiors spoken out (Carthey, 2003, p. ii16). The methodology of structured observation involves much more than simply arriving to the study site and making notes of observations and happenings. It requires observers to be trained, well-versed, or familiar to an adequate degree with the procedures or people being studied. In order to understand what is normal versus atypical behavior or procedure in a healthcare setting in

particular, it is important for observers to be familiar with how an ideal setting or procedure typically looks like. Thus, Carthey explains that decisions made to choose an ideal observer to conduct structured observations in healthcare settings should be based on "an appraisal of each candidate's personal skills, including the ability to win people's trust, to maintain attention for long periods, as well as their domain knowledge and observational experience" (Carthey, 2003, p. ii16).

There is a lack of adequate data on the status of water, sanitation, and hygiene in healthcare facilities in Cambodia. Structured observational research can help fill the gap in this data by aiding in the development of adequate WASH/IPC assessment tools. It can serve as the most important source of information for understanding health-related practices. One of the main advantages of conducting structured observations is that observers are able to collect data on an activity at the time and location in which it is occurring. Furthermore, it does not rely on people's willingness, ability to participate, or their providing of information (Taylor-Powell & Steele, 1996). It also allows observers to study people's actions directly as they occur rather than relying on what they convey or hear about them, and it allows the observer to provide a rich description of the studied event. Additionally, structured observations afford the researcher the ability to observe the behaviors of interest along with any associated behaviors or activities, giving the study more depth and breadth (Bentley et al., 1994).

Although conducting structured observations can be appropriate under the right circumstances, they have some drawbacks. The foremost disadvantage of this research method is that the data collected is susceptible to observers' interpretations and biases (Bentley et al., 1994). This disadvantage can be mitigated by involving multiple independent observers to collect data on the same activity or event. Conclusions would then be drawn from the corroborated data, which would increase the reliability and validity of that data.

Secondly, in a phenomenon known as the "Hawthorne Effect," people tend to perform their tasks differently and perhaps to a higher standard, when they know that others are observing them. Because of this, it is encouraged for the conduction of structured observations to be as indirect and discrete as possible to minimize interference with conduction of the target events (Taylor-Powell & Steele, 1996). Lastly, unstructured and structured observations may not necessarily increase the observer's understanding as to the completion of certain actions, as an observer should not ask observed individuals about their reasoning behind actions they commit.

Overall, unstructured and structured observation methodology have many strengths that this thesis study emphasizes. One of these strengths includes being able to provide additional qualitative data that can make quantitative data more enriching and meaningful. In addition, unstructured and structured observation methodology helps confirm whether official protocols and explanations healthcare staff verbally explain regarding protocols are truly implemented in the healthcare facilities itself. Lastly, this methodology elucidates the occurrence of adverse events, harmful practices, and logistical problems that future studies and interventions implemented in Cambodian hospitals should consider.

Research Study Overview

Problem Statement

Maternal and neonatal/infant mortality are commonly used as indicators of overall health of the maternal, neonatal, and infant population as well as the indicators for the effectiveness of the delivery of maternal and neonatal healthcare services (Hong et al., 2017). Reducing these deaths and improving health status and delivery are important milestones for local and regional governments as well as the international community. Cambodia has long suffered from high maternal and neonatal/infant mortality rates. Studies have shown that

much of the high death rates were attributed to nosocomial infections and that the majority of these deaths are preventable (Houy et al., 2017). Mothers, infants, and neonates are predisposed to infections during the perinatal period because of a relatively compromised immune system and several exposures experienced in healthcare facilities (Hong et al., 2017). In neonates, healthcare-associated infections, such as sepsis are the third-leading cause of death in Cambodian hospitals ("Cambodia Neonatal and Child Health Country Profiles," 2014). Variations in these rates are shown to be directly related to the health education levels of the mothers, families, and healthcare workers (Darmstadt et al., 2005). Maternal, neonatal, and infant deaths caused by healthcare-acquired infections could be prevented with proper infection prevention and control protocols and appropriate water and sanitation hygiene behaviors practiced among hospital staff and patients.

In settings with high mortality and relatively weaker health systems, increased dissemination of health education, improvement in home-care practices, and improvement in the healthcare practices of healthcare providers can lead to success in averting deaths in the maternal and neonatal/infant population (Darmstadt et al., 2005). These educational interventions that focus on IPC and WASH practices can be packaged as community-based interventions to target women of reproductive age as well as their families. Studies have shown that these types of initiatives can produce significant benefit to maternal and neonatal/infant care delivery, improve health outcomes, and greatly reduce mortality rates (Darmstadt et al., 2005).

Purpose Statement

Using unstructured and structured observations of hospital staff behaviors and practices, this study aimed to identify the pathways by which mothers and neonates are exposed to one or more of three bacterial strains of interest (*Klebsiella pneumoniae*, *Staph aureus*, and any strain of *Escherischia coli*). Observations focused on aspects of IPC and

WASH behaviors that may play a role in spreading healthcare-associated infections to mothers and their newborns. This study was designed to inform stakeholders and policy makers of existing obstacles to delivering effective maternal and neonatal/infant healthcare that concern IPC and WASH practices. The purpose of this study also intended to assist intervention implementers in planning what aspect of healthcare delivery to target in programs to address shortcomings in quality of maternal and neonatal/infant care.

Significance Statement

The occurrence of the high rates of morbidity and mortality for mothers and newborns due to preventable hospital-based bacterial infections calls the disconnect between knowledge, policy, and action to attention. In order to design interventions that can target the shortcomings in the healthcare facilities, it is necessary to recognize the specific mechanisms that spread hospital-based bacterial infections throughout the healthcare facilities. This study identifies certain improper IPC and WASH behaviors that can serve as conduits for transmitting infection from healthcare staff to mothers and newborns as well as among other healthcare staff. The results of this study can help bring attention to IPC and WASH behaviors, such as hand washing in maternity wards. From these results, stakeholders can plan and implement educational initiatives that would cover specific WASH topics. This will lead to improved healthcare hygiene-related practices that will result in reduced maternal and neonatal/infant morbidity and mortality.

Given that maternal and neonatal/infant mortality is at the forefront of Cambodian health goals, it is imperative to draw attention towards root causes of transmission between individuals in a healthcare setting. Interventions meant to address these behavioral aspects of transmission tend to be low-cost and effective at producing desired morbidity and mortality reduction results (Darmstadt et al., 2005). From this, program implementers can expand these efforts from healthcare-facility levels to community-levels to increase the dissemination of

IPC and WASH knowledge and to further improve the health status of the maternal and newborn populations of Cambodia (Darmstadt et al., 2005).

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Methods: Researchers conducted unstructured and structured observations of morning rounds, routine cleaning, and post-delivery procedures for one week each in the maternity wards of two hospitals. Researchers used notes from unstructured observations to develop an understanding of typical behaviors in settings of interest and to prepare charts for structured observations.

Results: Healthcare staff were typically not observed wearing gloves during patient interactions. Researchers found that this, as well as other inconsistencies in routine cleaning procedures, were related to the gaps in proper infection-prevention-and-control (IPC) training. In both hospitals, patients and their families in post-delivery rooms were responsible for bringing their own water, food, and hygiene materials, but observations found that many did not always bring hygiene materials with them. Lastly, structured observations found that cleaning and waste disposal procedures in Hospital B had several "poor" IPC practices, but generally adhered to "good" IPC practices in the delivery rooms.

Conclusion: This study has found that existing IPC training procedures need to be strengthened among healthcare workers of both hospitals. Additionally, water-and-sanitation-hygiene educational materials need to be taught or distributed to patients and their families to minimize possible spread of healthcare-acquired infections. Furthermore, water-and-sanitation-hygiene infrastructure needs to be improved in both hospitals to promote better personal hygiene and to provide easy access to safe and clean water for patients, their families, and healthcare staff.

Chapter 2: Manuscript

Introduction

Over the past 20 years, Cambodia has shown marked improvement in maternal and neonatal survival rates, with a trend in mortality rates among neonates decreasing by 2% every year from 1990 to 2012 and a decrease in maternal mortality by 75% from 1990 until 2010 (Bazzano et. al, 2015; Robertson, 2014). However, progress remains slow and giving birth in Cambodia continues to be laden with risks for women and their newborns. Recent studies have revealed that critical gaps remain in regards to implementing optimal healthcare practices and in reducing barriers to sustaining effective infection prevention and control practices during the delivery and postpartum periods for mothers (Bazzano et al., 2015). Infections such as sepsis, meningitis, and pneumonia have contributed to 40% of all neonatal deaths in Cambodia as of 2009, and these rates are most apparent in rural communities (Bazzano et al., 2015). On the other hand, hemorrhages, pre-eclampsia/eclampsia, and other direct causes contributed to maternal mortality rates in Cambodia as of 2010 (Adams & Al Sindhi, 2014). The direct causes of these neonatal and maternal deaths are largely preventable. These occurrences highlight the disconnect between knowledge, policies, and action. Therefore, the gaps in assessments of the environments and healthcare practices in these areas become a crucial step to addressing these disparities in maternal and neonatal health.

In order to study the potential pathways and transmission of healthcare-associated infections in maternity wards of Cambodian hospitals, researchers conducted a two-part study in two public hospitals in Phnom Penh. The first part of this study involved conducting unstructured and structured observations. Unstructured and structured observations were the most optimal methodologies to undertake as the primary parts of the study because they provided an organized method in which to note expected observations and adverse events.

Unstructured and structured observation methodology helped provide a general idea of the overall situations, typical procedures, and typical behaviors within maternity wards among healthcare staff, patients, and patients' families. This methodology provided valuable insight and qualitative data in real time of situations that microbial testing and environmental sampling complemented but could not present. The first phase of the overall research study examined the strengths and importance of conducting unstructured and structured observations in maternity wards in Cambodian hospitals. Through conducting unstructured and structured observations, researchers can more reliably identify mechanisms of possible healthcare-associated infections of *Klebsiella pneumoniae*, *Staph aureus*, and any strain of *Escherischia coli*. Additionally, this methodology can help identify gaps in infection prevention and control practices and water and sanitation hygiene behavior among hospital staff, on which there are minimal existing information.

Before conducting any type of methodology in Cambodia hospitals, it is important to discuss the history of Cambodia in order to understand the root causes of why Cambodia's healthcare system has struggled in its development. Additionally, by understanding Cambodian history, it helps explain why there is a disparity in the proper training and medical knowledge of healthcare workers in rural and urban areas in Cambodia as well as compared to other healthcare workers in Southeast Asia.

After the genocide led by the Khmer Rouge regime plagued Cambodia from 1975-1979, killing nearly two million or more Cambodians, the country suffered greatly from its losses, especially in regards to healthcare staff. Because of the massacre of educated individuals, low literacy rates, poor internal infrastructure, and inadequate healthcare systems within Cambodia resulted as an aftermath ("Health Service Delivery Profile," 2012). Lack of adequate education, poor infrastructure, limited training and skills to perform clinical procedures, and lack of data on maternal mortality have all contributed in some way to maternal and neonatal mortality ("Cambodia Global Health Initiative

Strategy," 2011). Among mothers in Cambodia, there is a maternal mortality rate of 170 deaths per 100,000 live births, which is higher than the government-set goal of reducing maternal mortality to 140 deaths per 100,000 live births by 2015 (Kimseng, 2015). Many mothers die from lack of access to emergency obstetric care and from the lack of trained birth attendants ("Cambodia Maternal and Perinatal Health Country Profile," n.d.). Furthermore, although infant mortality rates have improved, 53% of infants that fall in the under-five mortality group are between 1-59 months and mainly die from preventable illnesses ("Cambodia Neonatal and Child Health," n.d.). Within the under-five mortality group, 47% of those deaths are of neonates aged 0-28 days, and 18% of those neonatal deaths are a result of preventable, infectious conditions ("Cambodia Neonatal and Child Health," n.d.). Lack of adequately trained staff coupled with poor infection and prevention control protocols contribute to the high rates of maternal and neonatal deaths in Cambodia ("Cambodia Global Health Initiative Strategy," 2011). For these reasons, analyses of WASH-related procedures and pathways of infection within maternity wards are essential to better understand the current situation and propose evidence-based solutions for preventing WASH-associated HAIs.

Methodology

Research Design

A researcher used unstructured and structured observations in both Hospital A and Hospital B in order to identify these potential pathways of infection to be tested. For the purposes of studying the transmission of and potential sources for healthcare-associated infections among mothers and neonates, a researcher conducted unstructured observations for one week. These observations provided information on who interacts with mothers and neonates the most, what types of common items all mothers and neonates encounter the most, and what surfaces in specific aspects of the maternity wards mothers and neonates generally become exposed to the most in hospitals. Using information noted from the unstructured observations, a researcher created a series of charts to note specific observations of certain

aspects, behaviors, and contacts mothers and neonates had with certain people and objects during the unstructured observation period. Following the collection of this data, a researcher conducted structured observations over a span of two weeks, one week in each hospital. One researcher conducted unstructured and structured observations by silently observing behaviors and the general setting while standing or sitting in areas of the room where people generally directed less attention towards, such as the corners of rooms. The researcher used notes from structured observations to create and refine a list of surfaces, people, equipment, and objects to swab and rinse.

A researcher conducted structured observations in two public hospitals, Hospital A and Hospital B, in Phnom Penh. Based on access, researchers observed either 3 or 4 aspects of hospital maternity wards.

In Hospital A, a researcher observed three aspects of the maternity ward: routine cleaning procedures, patient post-delivery rooms, and morning rounds procedures. Structured observations in delivery rooms could not be conducted at Hospital A because the Emory research team was not granted permission to observe natural deliveries, which are rare occurrences at Hospital A where cesarean sections are the most common birthing procedures.

In Hospital B, the same researcher observed four aspects of the maternity ward: routine cleaning procedures, patient post-delivery rooms, morning rounds procedures, and natural delivery procedures. Midwives who were involved in all four aspects of the research study at Hospital B often rotated positions in different areas of the maternity ward or frequently walked in and out of the areas of interest in maternity wards.

Population and Sample

In Hospital A, individuals of interest who researchers observed included doctors, interns, patients, and patients' family members. In Hospital B, researchers were interested in observing midwives, doctors, interns, patients, and patients' family members. Based on data

from unstructured observations, researchers finalized a list of the aforementioned individuals of interest at each hospital because these individuals had the most observed contact with mothers and neonates.

Hospital A

Routine cleaning procedures typically involved up to 3 cleaners. On two separate days of structured observations, two of the same cleaners were present. On another day, an additional third cleaner, who was an intern, was present cleaning the delivery room.

Patient post-delivery rooms vary in terms of number of people in each room. There were three patient post-delivery rooms that each had as much as 5 but up to 10 beds in the rooms to house multiple patients at a time. The number of people in each patient post-delivery room varied because of different family members who would accompany mothers and babies at the hospital. Doctors and interns also walked in and out of the room at different times to check on patients.

Lastly, morning rounds procedures consisted of two interns who rotated shifts with other interns as noted during two separate days of structured observations of morning rounds procedures.

Hospital B

In delivery rooms, there were up to 8 midwives and one doctor who came in at the end of the delivery in the room at one time during one day of structured observations. On another day of structured observations, there were 6 midwives who entered or stayed in the delivery room.

Another prime example of rotation among hospital staff was during morning rounds procedures. On two different days of conducting structured observations, 3 midwives would conduct morning rounds procedures, but both days of observations consisted of a different set of up to 3 midwives who conducted morning rounds procedures.

Routine cleaning procedures were not consistent in terms of being conducted at specific times of the day, but from what was observed during structured observations, there was one cleaner who cleaned the patient post-delivery rooms and up to 3 cleaners who cleaned delivery rooms on both days of structured observations.

Patient post-delivery rooms varied greatly in terms of the number of people observed in them based on the family members who would visit or accompany the mothers and their babies at the hospital. Each patient post-delivery room is designed to house one patient and their family at a time.

Significance of Population Sample

The midwives, interns, doctors, and patients present during each observation period in the specific areas of the maternity wards within each hospital varied in terms of numbers and familiar faces. However, these population samples still served as valuable data for the overall research study despite its inconsistency because it provides important details that present a picture of how many people are typically involved in different areas of the hospital. Furthermore, the selected population samples provided ideas of potential causes of HAIs. For example, the more patients there are sharing a room within close proximity of one another, the higher the possibility becomes for people to spread HAIs among each other. Therefore, studying the size and types of people involved in sample populations within each hospital contributes more qualitative data in addition to presenting quantitative data.

Procedures

Initially, one researcher performed a one-week period of unstructured observations between both hospitals to test-trial data collection protocols. Following the practice, the same researcher conducted a week of structured observations at each hospital, focusing on potential pathways of environmental transmission of microbial contamination within the maternity wards. The researcher silently stood or sat in the corners of rooms or areas of rooms that were

relatively inconspicuous and were not disruptive to the hospital staff or patients. The researcher noted the different areas of the wards frequented, objects and surfaces touched most often, and behaviors of staff and patients. The notes were categorized into water-based behaviors and people-based behaviors, then further examined by actions associated with inadequate WASH behaviors. From these observations, a list of microbiological sampling locations was determined, prioritizing high-touch surfaces, invasive equipment, and the hands of healthcare personnel. The researcher carried out structured observations as discretely as possible. The researcher obtained verbal consent from mothers and their family members prior to entering post-delivery rooms and from midwives during morning rounds procedures. However, in some cases, mothers felt uncomfortable being observed, and the Emory research team was not granted permission to enter the rooms visited during morning rounds.

Instruments

One researcher developed four charts to note observations of each aspect being studied in each hospital in this research study, which included: routine cleaning procedures, patient post-delivery rooms, morning rounds procedures, and the delivery rooms only in Hospital B (See Appendix 1). These charts were based on previously collected data from the WaterAid Cambodia team on the infrastructure of and statistical data from the maternity wards at the National Maternal and Child Health Center in Phnom Penh. Additionally, the researcher used information obtained from an informal interview with a Nell Hodgson Woodruff School of Nursing student to help create the charts. The researcher noted certain equipment being touched or used in each hospital aspect as well as the types of people, number of people, and date and time of structured observations. The researcher then shared these notes with the rest of the research team for feedback and commentary to help collectively refine the list of objects to swab and sample as well as decide on which people to

conduct hand rinses on before any sampling took place. Lastly, the researcher used these refined lists to take notes during structured observation periods in both hospitals.

Final Selection of Sample Locations

Based on observational data results, the research team selected specific sample locations. A series of tables for each aspect observed within each hospital was created and filled in with notes on observations. Particular surfaces, objects, and equipment that were touched more often than others in a room were noted and compiled into a list to later be condensed into a final list of top three surfaces or objects to test based on the limited amount of swabs available. Furthermore, using the prepared charts for structured observations, one researcher noted certain cleaning and waste disposal behaviors from all healthcare personnel. The researcher then collaborated with the rest of the research team to determine what additional objects and surfaces should be swabbed for testing. Particular types of healthcare personnel who interacted with mothers and babies the most via physical contact or who were present the most often in certain rooms where mothers and babies were located were also noted and compiled into a refined list of hand rinses to be conducted. After discussion and consensus among five other research members from Emory, researchers compiled a final list was compiled to test each aspect of interest in Hospital A and Hospital B (See Table 1).

Findings that were behavior-based from healthcare staff were highlighted in yellow, and findings that were water-based, meaning behaviors directly related to interactions with water, such as using Hexianos solution to clean delivery beds, were highlighted in blue. Behavior-based findings that were highlighted in yellow included details about hospital personnels' behaviors that were particularly notable, such as using the improper rag to clean delivery beds and not using gloves to interact with patients. The yellow and blue highlights indicated "primary sources or behaviors of significant potential bacterial transmission." The highlighted findings were then used as a way to narrow down a list of sources for each aspect

of interest being studied in each hospital to be tested via environmental and microbial sampling.

Table 1: Final Selection of Sampling Locations

Hospital	Location within Ward	Type of Sample
Hospital A & Hospital B	Post-delivery rooms	• Bed rails at the foot of the bed • Surface of patient bed covers • Water and faucet handles from the sink faucet in Hospital B • Water and faucet handles from the faucet located directly outside patient post-delivery rooms • Door handles inside the rooms
Hospital A & Hospital B	Bathrooms	• Water and handle from sink faucet • Door handle
Hospital B	Delivery Rooms	• Surface of delivery beds • Water and faucet handle from the sink faucet • Door handle inside rooms
Hospital B	Main door used to enter delivery room hallway	• Inner edge of doors
Hospital B	Healthcare Workers	• Midwives • Doctors • Interns
Hospital A	Healthcare Workers	• Doctors • Interns

Ethics

The Institutional Review Board (IRB) of Emory University granted ethics approval on May 5, 2016. IRB approval was required for this study because it included human subject research. This study also received approval from the Cambodian Ministry of Health National Ethic Committee for Health Research (NECHR). The director generals and chiefs of maternal services at both hospitals granted the Emory research team permission to conduct the study and interact with their healthcare workers and patients. All participants who researchers collected samples and hand rinses from provided oral consent.

Results

After conducting one week of structured observations at both Hospital A and Hospital B, observing each aspect of interest within the maternity wards on two separate days each, different findings emerged for each aspect at both hospitals.

Findings at Hospital A

At Hospital A, one researcher observed three aspects of the maternity ward: routine cleaning procedures, post-delivery rooms, and morning rounds procedures. Structured observations in delivery rooms could not be conducted at Hospital A because Emory was not granted permission to observe.

Routine Cleaning Procedures

Routine cleaning procedures at Hospital A occurred at 6:00 am and in the evening at 6:30 pm. For this study, the researcher only observed the morning cleaning procedure. Structured observations of the morning routine cleaning procedure at Hospital A found that two to three cleaners were responsible for different parts of the maternity ward. Two regular cleaners cleaned the hallways and bathrooms, and the researcher observed both cleaners on both days of structured observations. Each cleaner mopped the hallway and bathrooms twice.

The third cleaner, a nursing intern, was cleaning used medical equipment in the delivery room on one day of structured observations. The researcher noted that cleaners did not wear gloves during the cleaning procedures.

***Pictured above**: A sink in the delivery room at Hospital A observed in the morning after routine cleaning procedures were completed in the hallways several hours before.*

Post-Delivery Rooms

There were three shared post-delivery rooms at Hospital A. Bassinets were available for use in post-delivery rooms and were primarily used to store food, drinks, and other personal items. None of the patients brought soap nor did the hospital provide it for patients. There were no visible trashcans inside the rooms. Open doorways led to an outdoor balcony area, which all three patient post-delivery rooms shared. The balcony area also had an outdoor tap available, which patients used to wash clothes and hang them to dry. This outdoor area also contained piles of empty plastic bottles and some trash, none of which were contained in bins. On some days, the researcher noted that the plastic bottles were contained in a large plastic bag, and other trash were contained in smaller plastic bags outside.

Picture 1 (left)*: Outside the patient post-delivery rooms at Hospital A. Pictured on the right side of the photo is the outdoor faucet area, which consists of white tiles.*
Picture 2 (right): *A large bag of used plastic bottles sits in the hallway of the patient post-delivery rooms.*

Morning Rounds Procedures

Morning rounds occurred at approximately 6:30 am daily. The researcher noted that gloves healthcare staff generally did not wear gloves. The researcher also noted that healthcare staff did sanitize their hands with alcohol hand rub at least once during morning rounds but not consistently between patients. In general, healthcare workers did not wash or sanitize their hands after physical contact with patients. Interns and doctors used sterile needles with plastic covers for each patient, and syringes were properly disposed of in cardboard safety boxes designed for sharps waste.

Pictured above*: A sink located outside a conference room where hospital staff occasionally discuss cases. This sink area is located directly around the corner from the delivery room. Pictured are a bottle of hand sanitizer and a cup of detergent on the shelf above the sink.*

Findings at Hospital B

At Hospital B, researchers observed four aspects of the maternity ward: routine cleaning procedures, patient post-delivery rooms, morning round procedures, and natural delivery procedures.

Routine Cleaning Procedures

At Hospital B, routine cleaning procedures were unstructured, and the schedule was unpredictable. Hospital cleaning staff conducted cleaning procedures multiple times a day at various times. The floor of the delivery room was mopped using water mixed with Lix, a cleaning product. Counters were cleaned using cloths and the antiseptic solution, Hexianos. Basins located at the foot of delivery beds were covered with protective plastic and emptied by separating the contents into their appropriate waste bins. Midwives sent equipment used during delivery to a different room for sterilization. Interns and midwives wiped the vinyl delivery bed covering with Hexianos solution and a white cloth. A midwife explained the uses of specific cloths to an intern, telling her that the green cloth should be used for general cleaning and the white cloth is used to clean blood and other bodily fluids.

The stretcher used to carry the mothers out of the rooms did not have a cover over it, and men carrying women on the stretchers did not wear gloves. On the second day of conducting structured observations, the researcher noted that the cleaners during that time were not designated cleaners. Instead, they consisted of several midwives and one intern. Hospital cleaning staff used different mops to clean bathrooms and patient rooms, and a specific mop was designated for the delivery room.

Morning Rounds Procedures

Morning rounds at Hospital B took place at various times. Midwives used a metal rolling cart to move equipment and medicine around from room to room. There was also a metal tray used to hold smaller medicine and equipment (such as needles and gauze) placed

on top of the rolling metal cart. Attached to that metal cart were infectious and sharps waste disposal bins. Midwives soaked dressing forceps used to check patients' wounds or apply medicine in Hexianos solution, and cleaned the metal tray holding medicine and equipment with alcohol and cotton. Midwives did not sanitize their hands, and the researcher did not observe glove-wear during patient contact. At the end of the morning rounds during one structured observation, the midwife cleaned the rolling metal cart using a white cloth and Hexianos solution. She also took equipment that she used during her morning rounds into the autoclave room for sterilization.

Post-Delivery Rooms

At Hospital B, each mother typically has her own room. For this reason, the researcher only observed two post-delivery rooms. The researcher noted the number of adults and babies, as well as the location of adults and babies, during the observations. Mothers and their babies were typically located on the beds, which were covered with a hospital-issued bed sheet. Other adults in the room sat on the floor next to the bed, where they ate and drank. Bassinets were present but primarily used to store personal items. Patients and their families brought in their own soap and detergent. All family members removed shoes at the door before entering the room.

Delivery Rooms

Hospital B granted the Emory research team permission to observe natural deliveries but not Cesarean sections. During a natural delivery, only one female family member is allowed in the delivery room. Males are typically not allowed to accompany mothers in labor into the delivery room. Midwives and interns are also present in the delivery room, but the number of each varies. Usually, there are 1-2 interns and anywhere between 4-6 or more midwives walking in and out of the room. Mothers are given sterile sarongs to wear before being inducted into the delivery room, and they are also given another sterile sarong to wear

upon moving to the post-delivery room. The vinyl bed cover was cleaned with Hexianos solution before the patient came into contact with the bed. The hook and thread were removed from sealed plastic bags. The forceps and scissors were autoclaved and packed into a sterile package to be opened only during delivery procedures. The researcher did not observe whether the rolling metal cart was cleaned prior to the patient putting her feet on top of it to make her delivery position more comfortable.

After birth, the midwife moved the baby to a flat surface that was covered with plastic wrap and wiped down with baby wipes. The midwife then inserted a sterile, plastic tube into the baby's esophagus via the mouth to suck out amniotic fluid. Afterwards, the midwife wrapped the baby in hospital-provided cloth before wrapping the baby in a towel that its mother brought with her. The researcher observed the primary midwife washing her hands with soap and water after the delivery procedure. The delivery room sink had soap, an automatic hand dryer, and a cloth to dry hands. A nearby sign that described proper hand-washing techniques was located on the wall near the sink as well as a sign displaying how healthcare workers in delivery rooms should properly wear personal protective gear.

The researcher did not record a final count of midwives and interns involved in delivery because many midwives walked in and out of the delivery room frequently. Doctors were not present during delivery in the delivery room.

Other Findings

Interestingly, at Hospital A, a doctor explained how it is the cleaner's responsibility to remove the trash from the outdoor area shared by patient post-delivery rooms daily during routine cleaning. However, based on structured observations, it was noted that these bags of trash were not removed often as the build-up of bottles but small number of total patients in all patient post-delivery rooms indicated. Additionally, one intern at Hospital A used a glove

to tie around a patient's arm to draw blood but did not actually wear gloves herself. In Hospital B, it is important to note that during one particular session of structured observations of routine cleaning procedures, an intern used a white rag and Hexianos solution to wipe both the bed and counters. However, after being told by a midwife that green rags are typically used to wipe more general areas and that white rags are used to wipe up blood and other bodily fluids, the intern acknowledged her mistake but did not wipe back over the counter using a green rag. In one particular day of structured observations of morning rounds procedures, when asked about her use of gloves during the morning rounds, a midwife explained that she used gloves to tie around the patient's arm if needed.

"I wear gloves sometimes, but my hands are clean and I use hand sanitizer, so it is not necessary to wear gloves."[1]*–Midwife at Hospital B*

On the other hand, although not observed during a structured observation period, it is important to note an example of a situation that could have been further observed through using structured observations to gain more clarity and understanding regarding the situation. In a situation at Hospital A, an intern mistakenly told researchers that a speculum had already been sterilized. However, after equipment rinsing was completed to collect the microbial sample from the speculum, the same intern returned to inform researchers that she was mistaken and that the speculum had in fact not been sterilized yet but was expected to be sterilized soon.

[1] Quotes from healthcare staff at both hospitals were translated into English from oral Khmer by the researcher conducting unstructured and structured observations.

"Because the hospital maternity ward does not clearly label what equipment have been sterilized or what equipment still need to be sterilized, it can lead to occasional confusion regarding the cleanliness of equipment." –Intern at Hospital A

Researchers could not have been inferred or deduced this information solely from collected samples in the research study without the conduction of these unique observations. Nevertheless, by following hospital staff around and observing their behaviors, the observational data collected from conducting structured observations provides a greater insight into and richer data towards possible HAI pathways of transmission.

Discussion

This assessment was able to compile data on a range of important components of WASH and IPC practices in Cambodian health care facilities. Using the unstructured and structured observational method, this research highlighted gaps in IPC practices and WASH education that can contribute to increased maternal and neonatal morbidity and mortality. These gaps included insufficient hand washing practices among patients, lack of sanitation materials such as hand soap and hand sanitizers, inadequate handling of biological waste materials, lack of glove use by healthcare staff when tending to patients, as well as a lack of research utilizing structured observational methods in hospital maternity wards.

In combination with environmental sampling and microbial swabbing techniques, data from laboratory readings was further supported with observational data to produce more reliable results. Environmental sampling and microbial swabbing techniques provided additional concrete scientific evidence on the state of bacterial contamination of healthcare staff, water samples, surface areas, and objects tested. However, structured observations confirmed the validity of healthcare procedures hospital staff stated that they implement.

Additionally, structured observation methodology is an organized approach that provides further insight on natural behaviors and situations among patients, healthcare staff, and interactions between both groups of these people. These natural behaviors and situations can be confirmed as opposed to simply reading about hospital procedures and staff interactions or only relying on what staff members and patients are telling research team members, which may lack details or obscure certain details. Being able to observe and note the compliance of hospital training with behaviors and practices implemented in the hospital maternity wards provides valuable additions that help formulate interventions to improve WASH and IPC practices in healthcare facilities

As described in a study on facility-based practices of normal labor and delivery practices conducted among four middle-eastern countries, three out of four countries "relied on reported rather than actual practices," and key informants were expected to "over-report practices they consider to be beneficial and underreport those considered problematic" (Choices and Challenges in Changing Childbirth Research Network, 2005). This practice is concerning because a large number of providers are implementing harmful or non-evidence-based practices due to the under-reporting of the issues considered to be problematic. Similar findings from the results of this thesis research corroborates with the findings presented by the Choices and Challenges in Changing Childbirth Research Network study. A midwife in Hospital B stated that she did wear gloves because her hands are clean, despite not washing them between patient interactions during morning rounds. This instance is an example of a healthcare provider implementing a harmful practice that can transmit HAIs to other patients or to other healthcare staff. Furthermore, it a practice that is not viewed, and thus not reported to be a problem. The findings from the study in the middle-eastern countries as well as from this study in Cambodia present how important it is to implement unstructured and structured observational methodology in order to provide a more accurate depiction of the IPC practices

and WASH conditions in hospital maternity wards. The results from the research study in Cambodia indicate that there is a lack of proper training and/or lack of reassessment of training of proper IPC and WASH practices among healthcare staff to lower the risk of transmission of bacteria. Therefore, if the risk of transmission of bacteria is lowered, the risk of transmission of infectious diseases that contribute to maternal and neonatal mortality will also be lowered. This calls for an evaluation of individual behaviors of patients and healthcare staff as they relate to proper WASH behaviors.

Deficiencies in these behaviors need to be properly addressed through sustained educational interventions in order to decrease the infection transmission rates within and outside health care settings. A study conducted by Luby et al, which assessed 50 villages in rural Bangladesh, showed a significant decrease of illness and disease rates after the implementation of sustained educational handwashing interventions at the community and health-facility levels (Luby et al., 2011). On a related note, possible biological mechanisms that may be involved in the transmission of HAIs in this research study conducted in Cambodia include unclean hands and improperly autoclaved medical equipment. If medical equipment are not properly autoclaved or sanitized before being used on patients, the risk of transmitting HAIs and of patients' susceptibility to contracting HAIs increases greatly in risk compared to if medical equipment were cleaned and properly sanitized before use. Improperly washed hands can also lead to a risk of transmission of HAIs similar to the ways in which improperly sanitized medical equipment can transmit HAIs among patients. For example, in a study of the effect of hand washing with water or soap on the hands of 20 volunteers that have been intentionally contaminated with bacteria, "bacteria of potential [fecal] origin...were found after no handwashing in 44% of samples" (Burton et al., 2011, p.97). However, the study also found that handwashing with only water "reduced the presence of bacteria to 23%, [and] handwashing with plain soap and water reduced the

presence of bacteria to 8%" (Burton et al., 2011, p.97). Thus, in a hospital setting, improperly washed hands may also transmit HAIs among healthcare staff members and vulnerable patients, such as mothers and neonates. The biological hazards that unclean hands and unsanitary medical equipment present among healthcare staff and patients can lead to serious medical conditions that include sepsis, meningitis and pneumonia, which can affect the mother and neonate (Bazzano et al., 2015). Coupled with complications in pregnancy and labor delivery, such as hemorrhages and pre-eclampsia/eclampsia, the risks of mortality among mothers increases greatly (Adams & Al Sindhi, 2014). Furthermore, the results from this research study can contribute to the work of setting a foundation for possible interventions to be implemented to address these gaps in knowledge and practices within the similar healthcare setting to work towards reducing maternal, neonatal, and infant mortality.

The implications of this research study's results are important for future studies that may be conducted regarding maternal and neonatal health, maternity wards in hospitals, IPC practices, and WASH behaviors in Cambodia. With strong commitment, the Cambodian Ministry of Health, has put forth a great amount of effort into reaching the set MDGs, and has made remarkable strides in addressing existing health disparities and in improving the lives of mothers, neonates, and infants. In order to continue its downward trend in maternal, neonatal, and infant mortality and upward trend in healthcare facility availability, strong government commitment is required. Research and interventions should be focused on increasing the utilization of existing healthcare facilities among rural Cambodians in particular. Furthermore, improving training on IPC practices and WASH behaviors in hospitals and among patients and their families need to be prioritized as this is a low-cost and high-impact strategy to implement.

Despite having poor rates of maternal and neonatal mortality rates compared to other Southeast Asian countries (ASEAN), Cambodia has made great strides in combatting this

healthcare issue. Since 1990 to 2013, Cambodia has reduced maternal deaths by approximately 66% since 1990 and neonatal deaths by 1.8% ("Cambodia Reduces Maternal Mortality," n.d.; "Cambodia Neonatal and Child Health Country Profile," n.d.). This improvement in maternal health has resulted from the increased access to adequate maternal healthcare and services throughout Cambodia (Liljestrand & Sambath, 2012). However, educational training on proper WASH and IPC practices is necessary to implement and improve among healthcare staff and patients in order to work towards Cambodia's downward trend of continuing to reduce maternal and neonatal deaths. For example, a doctor in hospital A explained how the reasoning as to why patient post-delivery rooms are not clean is because of patients who do not use trashcans. However, based on structured observations, the researcher observed that there were no trashcans in those rooms, which is an example of poor IPC practice and a gap in perceived behaviors and actual behaviors.

Healthcare facilities must be made more readily accessible, especially among rural Cambodians. The development of these healthcare facilities will supplement Cambodia's existing efforts to expand adequate maternal health access throughout the country, further decreasing maternal and neonatal/infant mortality rates. Particularly among rural Cambodians and poor communities that have less availability to access healthcare facilities, by training existing healthcare staff members and community members about proper handwashing techniques, it is the most low-cost, effective way in which to implement a behavioral intervention.

Limitations of the Study

This study was designed as a pilot project. Certain limitations should be taken into consideration when interpreting the results:

- Budget constraints within the research study limited the number of samples that could be collected, and as a result, the research study findings are not as reliable to apply across all aspects of the research study in the hospitals as they would have been had there been more samples collected. A collection of more samples to test would make results more reliable as it would present data in such a way that it should present consistent findings from which more accurate implications can be deduced.
- The lack of access and permissions to observe all of the rooms in the maternity ward as well as the inability to feasibly observe all patient post-delivery rooms in Hospital B can render inconsistent and less reliable data. By not being able to observe whether or not the same procedures or similar behaviors were conducted among patients and hospital staff in all rooms, it is inaccurate to assume that all rooms, all staff, and all patients practice and behave in similar manners in a hospital maternity ward setting. Additionally, the inability to observe natural birth procedures at Hospital A prevented the collection of richer and more-detailed data that could have greatly contributed to the findings of this study. Because the delivery process is the most invasive procedure that a mother has to undergo at the hospital, it is a crucial aspect of maternity wards to observe as the mother and neonate are at their most vulnerable to be vectors or recipients of HAIs.
- Although pictures could be taken of different areas within the maternity ward at Hospital A, pictures could not be taken at Hospital B due to security restrictions. Not being able to take photos of different areas of Hospital B limited the reliability of data by not providing images to further complement observations that would allow others who were not present at the site where research was conducted to see what the researcher observed.

Chapter 3: Public Health Implications and Recommendations[2]

As Cambodia evolves from a country devastated by war, continuous efforts are being made to improve healthcare delivery, healthcare practices, and population wellbeing. Among the primary goals of many healthcare programs is the reduction of maternal and neonatal/infant mortality rates. However, for these programs to be effective, the root causes of maternal and neonatal/infant mortality must be investigated in order to implement interventions specific to addressing these causes. A review of the literature surrounding WASH and IPC in Cambodian healthcare facilities yields few results regarding the evaluation of WASH and IPC behaviors in hospital maternity wards, which have been contributors to maternal and neonatal deaths. It is also important to note that there has been a lack of research done in Cambodian healthcare facilities utilizing structured observational methods, an important tool used for identifying specific routine or adverse behaviors of sample populations in target settings. Without a concrete understanding of which protocols carried out by healthcare staff are substandard and which specific behaviors are compromising the health of the mothers and newborns in the maternity wards, the current decline in mortality rates may be slowed. Structured observational studies can play crucial roles as knowledge translation strategies in order to bridge the gap between research and health policy and enhance the implementation of healthcare interventions. The primary goal of this study was to elucidate the WASH and IPC practices of healthcare staff and patients, whose behaviors and procedures can serve as potential pathways for infections to spread to mothers and their newborns. Identifying these pathways can highlight points of future interventions to improve

[2] Parts of this chapter are taken from a previously written report by Amanda Dam and Xinyue (Daisy) Wang addressed to the Ministry of Health in Cambodia.

WASH and IPC specific protocols; therefore, enhancing the overall quality of healthcare delivery, reducing and preventing the spread of HAIs, and increasing positive health outcomes. Not only can the use of unstructured and structured observations help provide valuable affirmation of whether or not certain practices spoken about or shared in training are implemented on ground. This research study provides examples of the important qualitative findings that unstructured and structured observations provide that quantitative data alone cannot show or explain, especially in regards to adverse events. These methodologies can be applied in health facilities throughout Cambodia as well as in any health facility in other countries throughout the world. Based on the pilot study results, the Emory research team reached several conclusions regarding recommendations for future implementations and areas of research:

1. Healthcare staff would benefit greatly from in-depth trainings on the promotion of IPC practices.

Throughout the study, a large number of hand rinses tested positive for the target microorganisms, and the observed patient encounters as well as several healthcare staff encounters lacked adequate hand washing. During deliveries, healthcare workers come into contact with bodily fluids that may be contaminated or can become contaminated from the surroundings. This makes handwashing critical in order to minimize the transmission of pathogens patients or healthcare workers encounter. After use during procedures, the researcher observed that medical instruments and cleaning equipment remained on counters or sinks without proper organization or proper labeling. Cleaning procedures were neither sufficient nor closely monitored, neither were they always consistent in terms of timing and execution in the patient post-delivery and delivery rooms. There is a strong need for periodic training on IPC practices for all staff, including cleaners. Posting signs around the hospitals to

use as nudges or reminders to practice proper IPC and WASH techniques would also be beneficial for healthcare staff.

2. Both hospitals need improved WASH infrastructure.

Without access to clean water and sanitation facilities that provide safety, privacy, and dignity to patients and healthcare staff, there may be a higher rate of poor hygiene practice, which could in turn affect the health outcomes of patients and staff (Bazzano et al., 2015). Hospital environments can be improved by enabling them to be more conducive to promoting better WASH behaviors and improving water quality. This can be done through installing on-site water filters (chlorination of water), maintaining functional hand washing stations, and providing soap or hand sanitizers to patients and all staff. Overall, improving the WASH infrastructure of both hospitals would result in better health outcomes among patients and staff.

3. Individual behaviors could play a key role in determining the health outcomes.

During the course of the study, the researcher observed some healthcare staff interacting with mothers and newborns without wearing clean, sterile gloves or not using soap and water to wash their hands. The health behaviors of healthcare staff indicate that the hands of healthcare staff may be a point of infection transmission. In addition, mothers and newborns were often taken care of by their family members. Without proper instructions on handwashing procedures or proper food preparation, family members may provide unhygienic services to mothers and newborns that could expose them to infections and illnesses. Further efforts to inform healthcare staff, patients, and their families about proper hygiene behaviors in healthcare facilities may effectively prevent the transmission of HAIs (Liljestrand & Sambath, 2012).

4. Future research on environmental sampling and monitoring are needed.

This study has shown the possible link between WASH infrastructure and environmental contamination. Further investigation is recommended to study routes of environmental transmission and to determine critical contamination points in order to develop target interventions.

5. Longer periods of unstructured and structured observations would add more validity to study data.

Longer periods of structured observations should be implemented in order to produce more consistent and reliable observations and notes regarding aspects of the hospitals being studied. Because of logistical, security, and bureaucratic issues that delayed a longer period of structured observations from being completed, the unstructured and structured observations period was relatively short compared to how long it could have been had the logistical and policy issues not occurred. Increasing the number of hospitals observed will also lend more generalizable study results and will further improve reliability.

6. Improved healthcare access and facilities must be implemented in rural areas of Cambodia.

Although there has been an increase in the number of deliveries in healthcare facilities as opposed to home deliveries, healthcare access in rural areas of Cambodia continues to be a problem in the present day (Matsuoka et al., 2010). Because of lack of access to healthcare facilities in these rural areas as well as a lack of availability of skilled birth attendants in home deliveries, mothers and neonates are at high risk of contracting bacterial infections, illnesses, and have higher possibility of mortality (Matsuoka et al., 2010). According to the

Cambodia Demographic Health Survey's data from 2010, nearly 90% of under-five mortality rates were attributed to children living in rural areas, and approximately 85% of under-five mortality rates were attributed to mothers with low-education attainment ("Cambodia Neonatal and Child Health Country Profile," n.d.). However, with access to more skilled birth attendants, knowledge of proper WASH practices, and access to more properly-equipped healthcare facilities, the rate of maternal and neonatal deaths could significantly decrease.

With the implementation of the aforementioned recommendations, Cambodia may elevate in status from being a country with one of the highest maternal and neonatal/infant mortality rates to being a country with the lowest rates in Southeast Asia. Cambodian healthcare facilities in other rural and urban areas struggling to reduce nosocomial infections, properly implement WASH and IPC practices, and struggling to lower maternal and neonatal/infant deaths may be able to use unstructured and structured observation methodology with support from data collected in this study to gain better insight into their own healthcare facilities starting with mother and neonates. Not only can this research be useful for Cambodian health facilities to use, but other countries around the world struggling with similar or worse maternal and neonatal/infant mortality rates compared to Cambodia may find the methodology and data from this study to be useful towards reducing their own losses of mothers and babies from preventable illnesses.

Appendix 1: Structured Observation Forms[3]

Routine AM/PM Cleaning: Time: Date:

Cleaner (A,B)	Use different mop to clean bathroom vs patient rooms?	Use of soap for mops or other cleaning products?	Floor of delivery room cleaned? (yes, no, partially?)	Counters cleaned? With what?	Basins at delivery chairs cleaned? With what?	What additional equipment used to clean?	Equipment and objects sterilized or autoclaved?	Additional notes or observations

[3] Each of the following structured observation forms were used twice to observe the 3 or 4 aspects within maternity wards in each hospital on two separate days.

Patient/Caregivers Observations (post-delivery): Time: , Date:

# adults in room	# babies in room	Location of mothers (bed, floor)	Adults eating? Where?	Adults drinking liquids? Where?	Stored items in bassinets?	Baby in bassinet (BA), on floor (F), or on bed (B)?	Use of antibacterial cleanser for hands? When is it used?	Brought soap to use in restroom?	Bed cover used? From where?	Additional notes and observations

Morning Rounds of Healthcare Personnel: Date: **Time:**

When are hands washed by healthcare personnel?	Physical contact with patients?	If not, who is engaging in physical contact with patients?	How many times are Cesarean patients' wounds changed?	Are catheters being checked?	Gloves used and changed after each patient interaction? (Y/N, Y/N?)	Soap available at each sink used?	Other objects touched by healthcare personnel in room besides patient?	Additional Notes and Observations

Delivery Rooms: Type of Delivery: , # people in room:

Positions of healthcare personnel in room:

Time: Date:

Delivery chair covered with hospital cloth: Wrap used to cover baby:

What kinds of tools are being used?	Sterile? Wrapped in cloth or from plastic?	Location of item	How did tool come in contact with patient?	How many times tools are touching patients?	Additional notes and observations
Scalpel					
Forceps					
Needle					
Syringe					
Scissors					

Delivery Rooms: Type of Delivery: , # people in room: , Positions of healthcare personnel in room:
Time: Date: Delivery chair covered with hospital cloth: Wrap used to cover baby:

What kinds of tools are being used?	Sterile? Wrapped in cloth or from plastic?	Location of item	How did tool come in contact with patient?	How many times tools are touching patients?	Delivery chair covered with hospital cloth?	Type of wrap used to cover baby	Additional notes and observations
Rolling tray table							
Heart monitor							
Ultrasound machine							
Oxygen tube for baby							
Catheter							
Wire used for stitching							

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