

Regional Disparities of Under-Five Mortality in China: Issues and Challenges for Improving

Child Survival

by

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Thesis submitted in partial fulfillment of
the requirements for the degree of
Master of Science in the Duke Global Health Institute
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ABSTRACT

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Abstract

Background: Over the past decade in the Millennium Development Goal Era, China has made great progress at the national level in decreasing the under-five mortality rate, but the progress has varied across China's regions with different socioeconomic development levels. These regional disparities in the under-five mortality rate (U5MR) raises concerns for improving child survival in the Sustainable Development Goal Era, especially when in depth studies on this particular indicator is absent. This study aimed to examine disparities in child survival and identify factors explaining the regional disparities in the U5MR in China, key lessons, and future priority areas for improving child survival.

Methods: This is a mixed methods study using quantitative data from secondary sources, mainly the National Chinese Statistical Yearbooks with some additional quantitative data from the Institute of Health Metrics and grey and peer-reviewed literature. The qualitative data collection involved key informant interviews of maternal and child health (MCH) administrators and practitioners in urban and rural MCH institutions in Yunnan province in China's western region and Hubei province in the central region. In Yunnan and Hubei, we conducted interviews at institutions both at the city level in the capital cities, Kunming and Wuhan respectively, and at the county/district level in Shaungbai and Caidian respectively.

Results: Socioeconomic, health-system related, and cultural factors were found to explain the regional disparities of U5MR in China. First was the regional income inequality, with Yunnan's rural population earning about 50% less than Hubei's rural population and its U5MR was more than one-third higher than Hubei's U5MR. The greatest gap of the U5MR existed between the urban and rural areas within regions and also in across rural areas in different regions, where the human resources for MCH were unevenly distributed. From 2004 to 2017

Yunnan had 32% increase in human resources for MCH whereas Hubei saw an almost 50% increase. The third factor was caregiver-related in which key informants reported parental awareness and taking preventative measures when taking care of children as reason for regional disparities. Disparity amongst children left behind in rural areas compared to their urban counterparts in terms of parental presence has been observed which can affect the parental awareness. Key lessons in improving child survival in the MDG era came from health financing with the three main social health insurance schemes and health service delivery with strict management for mothers with increasing rate of systematic maternal management nationally and regionally. Future priority areas for improving child survival were addressing the health workforce shortage in the pediatric and neonatal departments and health promotion and education for all caregivers, including mothers, parents and other family members.

Conclusion: Regional disparities in the U5MR revealed rural populations in the western region of China at a great disadvantage in regards to determinants of child survival. Key factors explaining these disparities are clear barriers to improving child survival and highlight the inequities persisting in child health and survival. Health is basic human rights and reducing child health disparities and improving child survival in rural areas across and within regions in China will reflect China's pursuit for health equity in the Sustainable Development Goal era.

Dedication

To my loving parents and siblings for their unwavering support and prayers throughout this chapter of my life. I love each of you more than words could ever express. At the end of the day, to God be the glory.

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1. Introduction

1.1 Child survival: Issues and challenges

From the 1990s until now, there has been a global decline in the number of deaths of children under the age of five years old. A major indicator in the decline of deaths in children under the age of five, is the under-five mortality rate (U5MR). According to UNICEF, U5MR is defined as the probability of dying between birth and five years of age per 1000 live births [1]. As of 2016, there were 5.6 million under-five deaths, a 50% reduction from 12.6 million in 1990 [2], highlighting an increase in the survival of children to at least 5 years of age. The increase in the survival of children under the age of five shows both resilience and children having the ability to reach their full potential as the next generation. Unfortunately, millions of children are still dying every year from preventable causes such as diarrhea, malaria, and neonatal infection. From a human rights standpoint, these preventable deaths highlight the global inequities that persist in child health and survival [3]. The global pursuit for health equity is defined by Dr. Braverman as “striving for the highest possible standard of health for all people” [4] involves reducing health disparities. The differences in the U5MR also described as disparities in the U5MR, are widespread with some countries having an U5MR of 2 and other countries with an U5MR of 133 [2]. However, the main area of concern is the recognized disparities within countries that are difficult to eliminate [5]. These scenarios are especially concerning where a country has achieved the reduction of under-five mortality at a national level. In terms of child health and survival, the disparities are numerous because maternal health is closely connected to the health of children under-five years of age. The disparities spanning maternal and child health (MCH) include but are not limited to, race, geography, gender, and health access.

For a long time, even with national declines in child mortality, many countries found

disparities in child health to be a challenge [6]. Due to child health disparities being a challenge for many countries, reducing these disparities have been national priorities, leading to a number of studies on child health disparities and their relevant indicators. In Brazil and the US, child health disparities only persisted amongst racial groups [7,8]. Iran saw geographical disparities in the infant mortality rate across provinces based on socioeconomic status. Japan saw regional disparities in the infant mortality rate (IMR) in the 1970s, but in the past two decades they have eliminated these regional disparities in the IMR. In the case of Japan the elimination of these disparities has been attributed to qualitative and quantitative improvements in health and medical services in Japan [9]. The quantitative improvements focused on bolstering the workforce numbers, health infrastructure, and financial benefits. The qualitative improvements include policies such as the Medical Care Plan that promotes quality healthcare in communities through adequate resource allocation [9].

Even in China, a country that achieved a 75% reduction in under-five mortality, child health disparities have been a problem and are still on the national agenda [6]. This has led to a plethora of studies on the disparities in infant and neonatal mortality rates in China, with a few studies on the under-five mortality rate. One study found an increase in the regional disparity of the IMR between the remote and coastal regions of China. Other studies highlighted how the western region of China is behind the central and eastern regions in terms of health outcomes coupled with a slower rate of decline in child mortality indicators [10,11]. Most of the literature on disparities in child mortality in China highlight imbalanced economic development and geographical divergence, such as urban-rural differences as major underlying reasons for the disparities [6,12,13]. As a result of these studies, there is a large body of quantitative evidence on regional disparities in child health focused on assessing level and trends of relevant indicators such as IMR and NMR in China with conclusions on factors impacting these disparities. The bulk

of child mortality studies in China focus on neonatal mortality and infant mortality. There is lack of in-depth studies on the U5MR, which is why this study focused on U5M and gathering qualitative evidence from service providers to explain reasons behind the regional disparities in U5M in China and determine priority areas for the health system moving forward. Qualitative evidence from service providers is crucial to the health workforce and service delivery, due to the ability to provide context for quantitative evidence presented in the literature on child health disparities. This evidence will provide insight on disparities in the under-five mortality rate in China, a less discussed topic, while providing key lessons and future priority areas for the health system to address. Lastly, in order to achieve health equity tackling these disparities and understanding the factors that characterize why these disparities exist from a health systems perspective is pertinent for improving child survival.

1.2 Under- Five Mortality in the Global Context

The available global trends for relevant child health indicators such as the under-five mortality rate allow for the visualization of disparities across regions and countries. The variations seen in these trends also highlight the preventable causes and risk factors of under-five deaths, bearing in mind the inequities children under five years of age face.

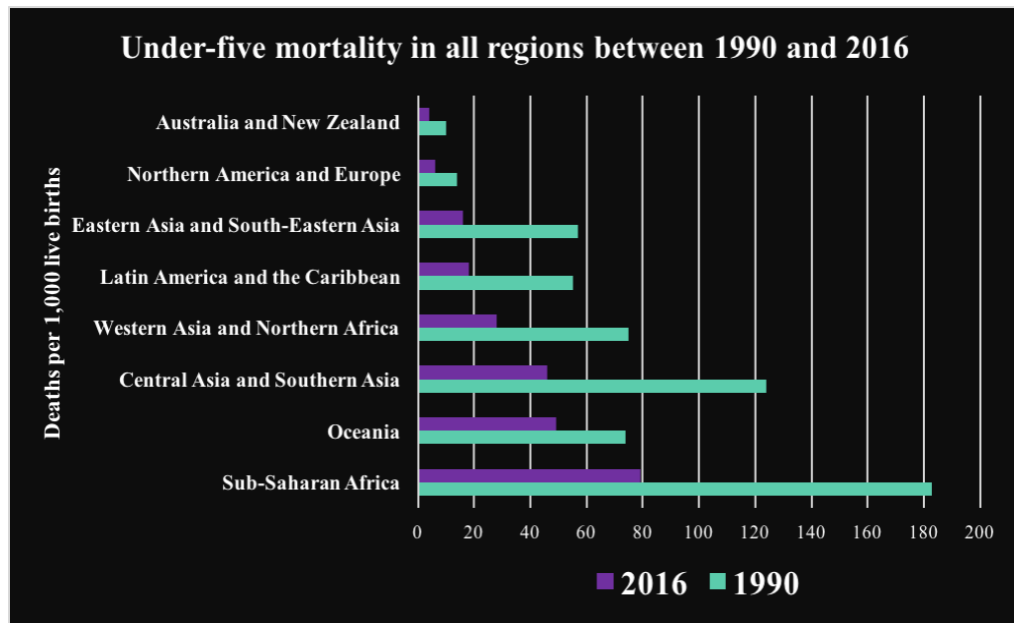
1.2.1 Under-five mortality

As of 2015, it is estimated that 16,000 under five deaths occur daily, which comes out to 11 children per minute [14]. From the 1990s to present, South Asian and sub-Saharan Africa regions accounted for the vast majority of these under-five deaths. Amongst the regions in Asia and Africa, Eastern Asia has maintained a lower prevalence of under-five deaths, with a U5MR of 10 deaths per 1000 live births in 2016 [2]. Although China is a testament to the reduction of under-five deaths in Eastern Asia with a country estimated U5MR of 10 in 2016, it is still one of

the six countries that account for half of global under-five deaths [2]. Lower-middle income countries like Nigeria accounted for 13% of global under-five deaths in 2015 while remaining in the top 10 countries with the highest under-five mortality rate [14]. Additionally, fifty-nine percent of lower- middle income countries account for the largest proportion of under-five deaths even though they do not collectively have the largest under-five population [14]. This disproportion is further evidence for the disparities globally present in child mortality and survival.

1.2.2 Global trends and disparities

As previously mentioned, the global trends in under-five mortality show a decline (Figure 1). However, the issue lies in the regional disparities present in the decline. Regional estimates for child mortality rates from 1990 to 2015 show the slowest decline in West and Central Africa at 50%, while East Asia and the Pacific had the fastest decline at 69% [14]. In sub-Saharan Africa 1 child in 13 dies before their fifth birthday, while the ratio in the world's high income countries is 1 in 189 [2]. The regional differences in the rate of decline and these ratios alone reveal the global disparities in child survival. The disparities are not only across region and countries; they also exist within countries. In Chad alone, under-five mortality ranges from 67 deaths per 1,000 live births in some regions of the country to 230 in other parts of the country [2]. In places like China, who were successful in in reducing under-five mortality at the national level, there are still some counties in China whose mean under-five mortality rate is higher than south Asia's mean under-five mortality rate of 55 deaths per 1000 live births [15]. Within-country disparities such as these don't receive as much attention. In the pursuit of global health equity and ending preventable deaths of children under-five, these disparities must be reduced and hopefully eliminated.



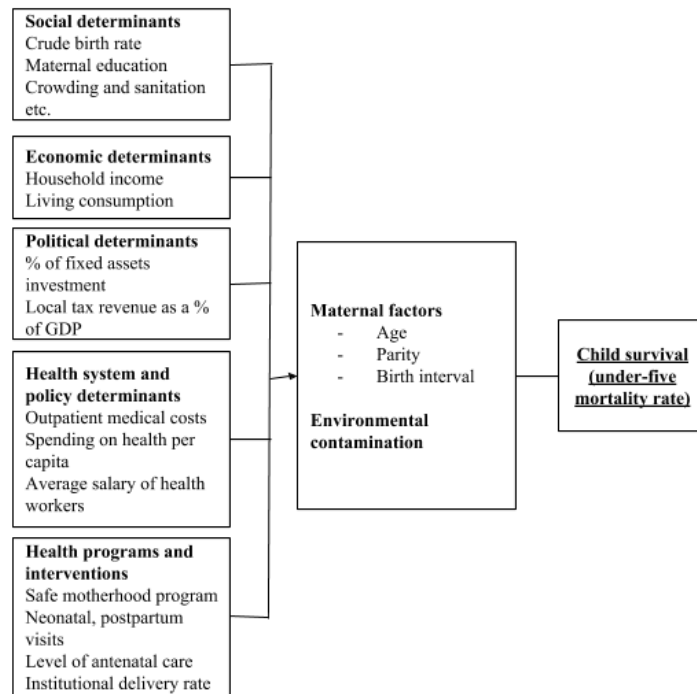
Source: Adapted from UNICEF Level and Trends in Child Mortality Report (2017)

Figure 1: Under five mortality rate in all regions between 1990 and 2016

1.2.3 Main causes and risk factors

As of 2015, at the global level the main causes of under-five mortality were pneumonia, preterm birth, neonatal intrapartum complications, diarrhea, neonatal sepsis, and malaria [14]. The unfortunate aspect of under-five deaths is that most are due to preventable or treatable causes such as pneumonia and diarrhea. In addition, the main causes of under-five mortality are not the same in every region. For example, in West and Central Africa, malaria was the main cause of under-five deaths, at about 24%. On the other hand, in South Asia the main reason for under-five death was the result of other causes at neonatal age [14]. The different social, economic and environmental risk factors of child mortality contribute to these regional disparities in the causes of under-five deaths. The risk factors themselves have different effects on children from country to country. For example, a child born in a low income country such as Mali, is 11 times more likely to die before the age of five than a child born in a high income country like France [14].

Socio-economic factors such as income, whether household or national, play a huge role in whether children survive past their fifth birthday. A study found that household income to had a significant impact on the neonatal mortality rate in Nigeria [16]. Simultaneously, under-five mortality is disproportionate across household incomes in low-middle income countries, with under-five mortality among children in the poorest households being twice that of children in the wealthiest households [2]. Besides household income, other factors impacting child mortality as referenced in the conceptual framework adapted from Mosley and Chen (Figure 2), include maternal education, spending on health per capita, level of antenatal care, and neonatal/postpartum visits. Depending on the geographical area, whether urban or rural, the factors affecting child mortality differ. A study of rural areas in China found that 25% of neonatal deaths in rural areas were due to home delivery while only 1.5% of neonatal deaths in urban areas where due to home delivery [12]. Unfortunately, the skills levels of village doctors and midwives in those rural areas were insufficient. Geographical differences in the skill levels of the health workforce is only one of many examples of urban-rural disparities impacting child mortality. Addressing child mortality as a whole requires not only tackling the direct preventable causes of under-five deaths but also the inequities children face in light of risk factors.



Source: Adapted from Feng et al. (2012)

Figure 2: Conceptual framework of social, economic, political, and health system determinants

1.3 Reducing Under-Five Mortality in the Millennium Development Goals Era

The reduction of under-five mortality rates has been due to a variety of factors, especially maternal and child health policies, strategies, and interventions. Many of these factors were a result of the Millennium Development Goals (MDGs). In the year 2000, 189 United Nations member states made a global commitment to achieving the MDGs. This global commitment consisted of eight goals, dedicated to issues ranging from poverty to global partnership. In regards to child health, MDG 4 was to reduce the under-five mortality rate by two-thirds between 1990 and 2015. The MDGs led to increased global attention on child mortality, which brought together many NGOs, foundations, and multilateral donors under the same goal to reduce child mortality. The policies, strategies and interventions resulting from the MDGs have impacted two

key elements of the health system, namely health workforce and service delivery. Taking an account of the factors that helped reduce under-five mortality will provide key lessons for improving child survival moving forward.

1.3.1 Policies, Strategies, and Interventions

There have been many success stories for reducing under-five mortality. All of the regions except for Oceania and North America have seen more than a 50% decline in the U5MR since 1990 [2]. Of the countries that reduced the U5MR by two-thirds, 28 were low or lower-middle income countries, this means the aforementioned regional disparities can be overcome [2]. The policies, strategies, and interventions globally and nationally have ensured these success stories. The Success Factors studies, a multidisciplinary, multi country study, highlighted the multi-sectoral progress and catalytic strategies to maximize health outcomes, that some countries used to reduce maternal and child deaths [17]. In places like Bangladesh, one of the most densely populated countries, the U5MR went from 151 to 65 between 1990 and 2006 [18]. Bangladesh success in reducing under-five mortality was attributed to a successful family-planning program and expanding immunization coverage [18]. In that same time frame immunization coverage in Bangladesh went from 54% to 81.9% [18]. One of the success stories in sub-Saharan Africa was that of Malawi, who achieved MDG 4 in 2013. Estimates for Malawi show a 73% decrease in U5MR between 1990 and 2015. A case study on Malawi found that since 2000, vaccinations, insecticide-treated bed nets, HIV control, integrated management of childhood illnesses, nutritional support, and obstetric care, account for 80% of the reduction in child mortality in Malawi [19].

Integrated management of childhood illness (ICMI), a strategy developed by the WHO and UNICEF, focusing on the top killers of under-five children is one of the main strategies for improving child survival. ICMI is a multifaceted strategy tackling health system improvement,

training of human resources for health, and community practices. Most countries in sub-Saharan Africa have implemented ICMI, with one of the success stories being Tanzania with a 13% reduction in under-five mortality in two years [20]. Bangladesh saw an increase in healthcare seeking behavior and quality of care at the health facilities with implementation of ICMI [20]. In addition to this strategy, immunizations have been one of the most effective child survival interventions [3]. The Expanded Program on Immunization (EPI), initiated by WHO main goal was to vaccinate children throughout the world. Vaccinations for measles, pertussis, and neonatal tetanus has been estimated to have averted 3 million child deaths annually [21]. Based on the guidelines set by the EPI, many countries created and implemented their own policies for vaccination programs.

In China, one of the strategies employed for improving child survival involve integrating the care of mothers and children through initiatives such as the National Program for Children's Development (2001-2011) and the National Program for Women's Development (2001-2011). The children's development program focused on four areas regarding children, specifically health, education, legal protection, and environment. The women's development plan aimed to protect and empower women which included ensuring access to healthcare. In addition, there has been government focus on essential health interventions, such as the Program to Reduce Maternal Mortality and Eliminate Neonatal Tetanus, which led to an increases in the hospital-delivery rate. This program, initiated in the year 2000 in western China, targeted national poverty counties with high rates of maternal mortality and neonatal tetanus [22]. Another strategy was capacity building within the health system, which under the 2009 health reform called for, for "strengthening the medical and health service system at grassroots level" [23]. These are only a few of the many policies, strategies, and interventions that influenced child survival in China [24]. One thing to

note, at the cornerstone of all the success stories on improving child survival was addressing maternal and child health together.

1.3.2 The Role of the Health System in MCH

The WHO framework breaks the health system into six building blocks, namely service delivery, health workforce, health information systems, access to essential medicines, financing, and leadership/governance [25]. These blocks interact together to affect health status. In this case we will focus on the impacts of one major input and output of the health system on maternal and child health (MCH) care and outcomes, namely health workforce and health service delivery/provision. The chosen focus on health workforce and service delivery/provision in MCH is for two reasons.

First, the importance of maternal health in regards to child health stems from the impact a mother's health has on her child. According to the WHO, maternal health refers to the health of a woman during pregnancy (antenatal), childbirth, and after childbirth (the postpartum period) [26]. Many things affect the mother and child at any of these three time periods, but one of the main factors is maternal healthcare. Whether women receive health care or not contributes to birth outcomes which further impacts child survival. The postpartum period is a critical period for mothers and newborns, but in less developed countries only 39% of mothers and 26% of newborns receive a postnatal checkup [14]. Infant and child mortality is seen as an adverse outcome associated with maternal mortality [27]. Maternal mortality refers to the death of a woman during pregnancy or up to 42 days after birth of her child. Direct causes of maternal deaths also lead to an increase risk in the chances of a newborn dying after birth [27]. Therefore, interventions pertaining to causes of neonatal deaths are linked to interventions targeted towards causes of maternal deaths. Furthermore, confirming the emphasis on quality, skilled care before, during, and after birth as a major key to reducing neonatal deaths. It is estimated that 40 percent

of neonatal deaths can be avoided if quality, skilled care is provided around the time of birth for both the mother and the newborn [14].

Secondly, the provision of quality and skilled maternal and child health (MCH) care depends on many factors, particularly such as the healthcare personnel (health workforce) and the services they provide (health service delivery/provision) as a result of other blocks in the health system (financing, leadership/governance, information systems, and medical products). These factors operate within a health system, whose main goal is to improve health through the combination of resources and various actors. An effective and efficient health system can lead to improved health status [25]. Indicators such as the under-five mortality rate and the maternal mortality rate inform us of the health status of women and children and show there is room for improvement. Understanding how the health system impacts areas such as maternal and child health care is key to improving the health status of women and children.

Generally speaking, all systems have inputs and outputs. The health workforce is one of the major inputs in the health system. The health workforce refers to the people involved in directly organizing and delivering health services. The knowledge, skills, motivation, and distribution of these health workers have major implications on health outcomes. Studies have shown that the density of the health workforce in particular has an impact on the effectiveness of interventions. The ability to achieve 80% of measles immunizations and skilled attendants at birth is more likely when worker density is above 2.5 workers per 1000 population [28]. A study in Vietnam found positive impacts of the number of health workers on the reduction of under-five mortality and infant mortality rates [29]. Even if a country has a high number of health workers, unequal distribution of these health workers can be a barrier to improving health outcomes. For example, health reforms in Vietnam lead to allowing medical graduates to pick where they wanted to work, which allows for an imbalance in the distribution of health workers due to

graduates not choosing remote and rural areas [29]. On the other hand, many countries in Africa face a detrimental shortage of healthcare workers with a deficit of 2.4 million doctors and nurses [30]. Shortage of personnel at health care facilities also affect utilization of MCH care. Women in Southern Malawi expressed the lack of the desire to go to seek services at healthcare facilities if there weren't any professionals there to attend to them [31]. In addition to the distribution, the skills of health workers play an important role in maternal and child health care. For example, community health workers trained in Integrated Management of Childhood Illness (ICMI) are more likely to correctly classify illnesses [32]. This type of skill is key to ensuring appropriate treatment, therefore leading to improved child health outcomes.

One direct output of the health system as a result of the health workforce input is service delivery/provision. Health system financing and access to essential medicines are aspects of the health system that impact health service delivery/provision. The four key areas of service delivery are access, availability, utilization, and coverage [25]. The WHO defines service delivery as “a fundamental input to population health status” [25]. Furthermore, under-five mortality and also maternal mortality are some key indicators of population health status. This emphasizes the undeniable linkage between service delivery and maternal and child health outcomes. The well-organized service delivery system in China was one of the major contributors to the improvement of MCH in China [33]. An organized service delivery system allows for better access to care.

In China's current health system, health workforce and service delivery/provision are both under the governance structure of China health supervision system. The main governing body is National People's Congress (NPC), which has produced 11 health laws and 38 regulations. The 1994 Law on Maternal and infant Health Care in China, recognized the importance of maternal health care, with its standards and protocols to address quality of care [33]. The National Health and Family Planning Commission (NHFPC) and the State

Administration of Traditional Chinese Medicine (SATCM) are two of the major health administrative bodies stemming from the NPC. China's health system has five levels, state/national, provincial, city, county/district, and the township level. The NHFPC has local authorities at the provincial, city, and county/district levels.

The governing body in China has a clear career development system for health professionals working in the public sector, divided into primary, intermediate, and advanced. Going through the comprehensive medical education system is the first part to entering this career development system. The policies in place have evolved over time and impacted the distribution of professionals in the health workforce after going through the education system. When the employment policy became more flexible allowing graduates to choose where they wanted to work instead of being allocated by the state government, they chose well-developed areas over rural area. An uneven geographical distribution of the health workforce impacts health service delivery and the services provided in urban areas in compared to rural areas who have difficulty retaining healthcare professionals [34].

China's health service delivery system, covering over 1.3 billion people, is divided into a medical service delivery system and a public health system. The medical service delivery system covers the hospitals at four levels, provincial, city, county/district, and grassroots. The traditional Chinese medicine service system is also included in this system. The medical delivery system has a urban and rural component. County-level hospitals are responsible for the basic public health services in the rural component, while community-level institutions are responsible for basic public health services in the urban component. Some of the hospitals also have a maternal and child health department. The concentration of health resource allocation in hospitals emphasizes the dominant role public hospitals play in the medical service delivery system and public health system [34].

The public health system includes institutions such as maternal and child health institutions (MCHI), disease prevention and control institutions, health supervision institutions, and mental health professional institutions. These institutions have jurisdictions at the state, provincial, city, and county levels. The overall health service delivery system is mostly established, operated, and monitored by local governments at the provincial, city, county/district, and township levels. The central government is involved but plays a larger role in major public health programs. There are a several other actors that play important roles in health administration in China, including, but not limited to, the Ministry of Human Resources and Social Security, Ministry of Civil Affairs Ministry of Finance, and Ministry of Education, etc. [34]. The complexity of all the factors and actors within China's health system have contributed to the status of maternal and child health in China.

In addition to all the health system related factors affecting MCH, there are some factors outside the health system that also impact MCH. Examples range from socioeconomic to culture. These factors tend to impact the utilization of maternal and child health care and can serve as barriers to accessing MCH care. An ecological analysis of 46 African countries listed "access to healthcare" as a factor for the declining under-five mortality rates from 200 to 2013 [35]. In terms of maternal and child health, access to health care includes antenatal care, delivery services, post-natal care, immunizations, infant and young child feeding, and integrated management of childhood illnesses [35]. Access to MCH care does not always translate to utilization of the services due to barriers seeking MCH care, which in of themselves differ between and within countries. Barriers such as educational level was seen in a study on maternal health services utilization in Uganda. The study found that women with secondary or higher education were more likely to use the maternal health care package than women with no education [36]. Furthermore, an exploratory study in Nepal, a country where underutilization of services is the

reason for poor health outcomes in women and children, found social factors such as family pressure, misconception, negligence, and illiteracy to be barriers to utilization of health services [37].

When considering the various aspects within and outside the health system and the different angles at which they impact maternal and child health, the plans to improve maternal and child health outcomes become complex and presents challenges.

1.4 Unfinished agenda on health MDGs in the SDG era

In the year 2000, 189 United Nations member states made a global commitment to achieving the MDGs. This global commitment consisted of eight goals, dedicated to issues ranging from poverty to global partnership. In regards to child health, MDG 4 was to reduce the under-five mortality rate by two-thirds between 1990 and 2015. The MDGs led to increased global attention on child mortality, which brought together many NGOs, foundations, and multilateral donors under the same goal to reduce child mortality. Throughout the MDG era, there were several concerted efforts at the global level to reduce child mortality. Examples include but are not limited to A Promise Renewed, The Measles and Rubella Initiative, and Every Woman Every Child. Despite all these efforts, at the end of the MDG era MDG 4 was not achieved at the global level. However, at the regional level, East Asia and the Pacific and Latin America and the Caribbean achieved the MDG 4 target [14]. At the national level several low income countries also achieved MDG 4, namely, Eritrea, Ethiopia, Liberia, Madagascar, Malawi, Mozambique, Niger, Rwanda, Uganda, and Tanzania [38].

Out of all the countries that achieved MDG 4, China was the one to achieve it in 2008, years ahead of the 2015 deadline [15]. By 2006 China's under-five mortality rate dropped by 54.2% from what it was in 1996 [39], which was only a few percent away from the $\frac{2}{3}$ reduction

target of MDG 4. Economic development and several health reforms targeting women and children allowed for the decline in the under-five mortality rate and the early achievement of MDG 4. At the same this rapid economic development led to increasing health disparities [40].

Despite the achievements of the MDG era in countries like China, Ethiopia, Bangladesh, and Egypt, many challenges still remain for the new Sustainable Development Goal (SDG) era, a much detailed continuation of the MDG. The challenges that remain are both global and specific to China. The latest global statistic that every minute 11 children die before their fifth birthday alludes to the remaining challenges [2]. This means moving forward, there is still work to be done in child, newborn, and maternal survival [41]. Progress towards reducing neonatal mortality has been slower than in under-five mortality. The concern arises because neonatal deaths account for almost half of under-five deaths, a 5% increase from the proportion it accounted for in 2000 [2]. Estimations with current trends show that approximately 60 million children under 5 years old will die between 2017 and 2030, and half will be newborns [2]. Even in western Europe, UK has one of the worst rates of neonatal and under-five mortality. Hence, globally speaking addressing the prevention of neonatal deaths is a major challenge. Additional challenges remain for improving child survival and they vary across and within countries. Food security poses a challenge in places like Niger where most of the population is rural and depends on agriculture as their source of income generation and can impact childhood nutrition [42]. Another challenge for child survival in the SDG era include prioritization of child health research, especially in places like the UK less than 5% of total public sector and charitable research funding is aimed at child health [43]. Many challenges occur under health financing with lack of financial risk protection and under human resources for health with the health workforce crisis in many countries. For example, a study in Zimbabwe found that the insufficient health workforce was one of the main

challenges to improving child survival, due to the impact on availability, quality, and utilization of life-saving health services.

In the case of China, the unresolved regional gaps in the under-five mortality rate in China are a major challenge in the SDG era. Despite China achieving MDG at the national level, a recent study in the Lancet shows that this achievement did not reflect across all areas of China [10]. The western region and rural parts of China are behind other parts of China in terms of progress towards MDG 4 [10]. This suggests that major disparities exist not only in the under-five mortality rate across China but in factors related to child health and improving child survival. One major challenge to addressing these disparities and improving child survival is the shortage and imbalance of pediatric human and medical resources. Data shows that there are 0.53 pediatricians per 1000 children in China, whereas in developed countries the number is from 0.8 to 1.5 [44]. This challenge coupled with the new two-child policy started in January 2016 presents more challenges. The new two-child policy aims to address the aging issue in China but presents a potential impact for maternal and child health since more children are being born to mothers older in age therefore contributing to problem of birth defects rates in China [44]. These are just a few of the many challenges China faces in the SDG era with achieving the main health-related goal, SDG 3. SDG 3 aims to “ensure healthy lives and promote well-being for all at all ages”. SDG 3.2 is specifically dedicated to ending preventable death of children under 5 years of age by 2030 [45]. In order to end preventable deaths and achieve health equity for children moving forward in China, it is necessary to understand the lessons learned in China’s achievement of MDG 4 and the reasons for the regional gaps in key indicators such as U5M amongst different regions.

1.5 Aims and Objectives

This thesis is a small subset of a larger Gates-funded project aiming to achieve the health-related Sustainable Development Goals (SDGs) in China. Despite China's immense progress on the Millennium Development Goals, there are challenges in implementing the new health-related SDGs in China. These challenges include but are not limited to regional, urban/rural, and gender disparities that persist despite previous gains in areas such as maternal and child health. The larger project aims to generate evidence-based approaches and offer policy options that can be used by the Chinese government to develop and implement effective health policies and achieve health equity in across China.

The aim of this study is to identify what factors explain the regional disparities in the under-five mortality rate in China, and to leverage lessons from the MDG era in order to help China end preventable deaths of newborns and children under 5 years of age and achieve health equity for children. The specific objectives of this research are:

1. Examine the regional disparities/gaps through secondary data indicators related to under-five mortality and child survival
2. Understand MCH professionals and administrator's perspectives on factors explaining the regional disparities and future priority areas to further improve child survival
3. Provide lessons learned from the MDG era in China and propose policy recommendations for improving child survival and reducing disparities in the under-five mortality rate (U5MR) among different regions in China.

1.6 Thesis Organization

The next four sections of this thesis will be organized in this manner: starting with a detailed description of the mixed methodology used in this study, the second section will present the quantitative and qualitative results in an integrated chronological manner from past key lessons, to present reasons for the regional disparities, to future priorities for the unfinished agenda on child survival. The discussion section will discuss the implications of key findings, interpretations, and study limitations. The final section will detail the conclusions of this study.

2. Methods

2.1 Study Design

This study design primarily consisted of qualitative and quantitative data collection in order to fulfill the study aims. Quantitative data collection of secondary sources involved a review of the literature and searching open access data sources such as the Chinese National Health Statistics Yearbook for trends in relevant indicators. Qualitative data collection involved key-informant interviews with health care providers and administrators in maternal and child health departments and/or institutions in urban and rural areas in Hubei and Yunnan province. This study is a subset of a larger project aiming to develop evidence-based policy options the Chinese government could use to meet the health-related SDG goals and achieve health equity throughout China. The larger project focused its analysis on three economically different provinces in China- Jiangsu, Hubei, and Yunnan province. These provinces, respectively represent the high, middle, and low-income regions of China.

2.2 Study Sites

China is generally divided into three regions, the eastern, central, and western regions, which respectively represent the high, middle, and low-income regions of China. The eastern region of China has made great achievements in under-five mortality attributed to greater economic development, which is not easily transferable to low and middle income regions. Therefore, due to the achievements in the eastern region, and the desired smaller scale for this study's approach to the regional disparities in the U5MR, we focused on the western and central regions from which Yunnan and Hubei Province were respectively selected for this case. Yunnan and Hubei are two economically and geographically different provinces in China, Yunnan province in the western region, and Hubei province in the central region. The choice of these two

provinces allowed for exploration of different provider perspectives on the factors explaining the regional disparities in the under-five mortality rate in China, provision of key lessons in MCH, and the priority areas for child survival. Table 1 compares key indicators in each province.

Table 1: Key indicators from Yunnan and Hubei Province

	Yunnan Province	Hubei Province
Resident population (persons)	47,710,000	58,850,000
Number of prefectures	16	13
Number of Counties	69	37
Nominal Gross domestic product (GDP) (1 CNY=\$0.14 USD)	1,478,842 yuan (CNY)	3,266,538 yuan (CNY)
GDP per capita ranking out of 31 ranks	30 th (bottom third)	11 th (upper middle)
Under-five mortality rate (2012)	20.83 deaths per live births	13.23 deaths per 1000 live births

* all data is from 2016 except for the under-five mortality rate

Sources: National Chinese Statistical Yearbook

Yunnan province, with a resident population of 47,710,000 (2016), had a GDP of 1,478,842 in 2016. Yunnan is comprised of 16 prefectures and 69 counties. On the other hand, Hubei province, has a resident population of 58,550,000 and a gross domestic product (GDP) 3,266,538. Hubei is comprised of 13 prefectures and 37 counties. Hubei gross domestic product (GDP) ranks 11th while Yunnan ranks 30th out of 31 Chinese provinces. In terms of this study's main indicator, U5MR, as of 2012 Yunnan's U5MR was 20.83 deaths per 1000 live births while Hubei had an U5MR of 13.23 deaths per 1000 live births. The key informant interviews took place in an urban and rural area in each province. In each province, half of the informants were from an institution located in an urban area and the other half in a rural area. In Hubei the institutions were in Wuhan (urban area) the capital city and Caidian (semi-urban area). In Yunnan the institutions were in Kunming (urban area) the capital city and Shuangbai (rural area). One institution asked to remain unnamed in any study reports, therefore for simplicity all institutions

will be unnamed in this paper. The urban areas for each province were in the capital cities, Kunming (Yunnan province) and Wuhan (Hubei province). The rural area selected for Yunnan was Shuangbai, and Caidian for Hubei.

2.3 Data Collection

2.3.1 Quantitative Data Collection

The main quantitative indicators selected and used in this study are detailed in Table 2 below. The under-five mortality rate (U5MR) is defined as the probability of death under five years of age per 1000 live births [1]. According to the National Chinese Statistical Yearbook, income from wages and salaries of urban and rural households is comprised of income from labor (including wages in major occupations and other labor such as a second job) earned by member of the household. Per capita income is the level of income average for by population, separated by urban and rural. The local government expenditure for medical and healthcare includes health care management expenditure, health services expenditure, medical security expenditure, disease control and prevention expenditure, health supervision expenditure, motherhood and child protection expenditure, rural health spending, etc.

Table 2: Main Indicator Definitions

Indicator	Definition	Source
Under-five mortality rate	The probability of death under five years of age per 1000 live births	National Chinese Statistical Yearbooks
Per capita income from wages and salaries of urban and rural households	Income from labor (including wages in major occupations and other labor such as a second job) earned by member of the household.	National Chinese Statistical Yearbooks
Local government expenditure for medical and health care	Health care management expenditure, health services expenditure, medical security expenditure, disease control and prevention expenditure, health supervision expenditure, motherhood and child protection expenditure, rural health spending, etc.	National Chinese Statistical Yearbooks
Number of MCH institutions	Number of women and childcare agencies	National Chinese Statistical Yearbooks
Number of MCH personnel	Number of physicians in MCH institutions	National Chinese Statistical Yearbooks

Major Sources: National Chinese Statistical Yearbooks

Overall, the quantitative data used was collected from these secondary sources:

- National Reports - Chinese Statistical Yearbooks, China’s Health Statistics Yearbooks, and China’s Health and Family Planning Statistical Yearbooks
- Global Burden of Disease (GBD) data from Institute of Health Metrics & Evaluation(IHME); UNICEF reports
- Grey literature and peer-reviewed articles on U5MR and related indicators globally and within China

In September of each year the National Bureau of Statistics (NBS) in China has published a statistical yearbook. The National Bureau of Statistics is China’s official statistical agency under leadership of the State Council [46]. The NBS functions at all levels (national, provincial, city/county, and township) and is responsible for collecting, aggregating, compiling, and providing statistical data from surveys and census they conduct. An example of a survey is the National Health Services Survey (NHSS), a nationally and sub-nationally representative

household survey. NHSS evaluates the needs of urban rural residents and the availability and utilization of health services and insurance programs [47]. NHSS is administered by local health workers supervised by doctors. Health-related data in the statistical yearbooks come from China's health information system which has many subsystems. The Routine Health Statistical Information System annual collects data on health facilities, human resources, and equipment and services provided. The Disease Surveillance System reports on over 30 infectious diseases. The National Household Health Services Survey collect data on access to care, health status, demands to utilization, satisfaction, and expenditure. The Maternal and Child Health Care Surveillance System collects data on maternal and child health care every year. Lastly, the Health Supervision Information System, annually collects data on public facilities, schools, food, and environmental change [48]. The various laws and regulation such as the Statistics Law, and the National Health Statistics Management rule requires health administrations and facilities at all levels to report accurate and complete data in a timely manner [34]. All this data can be found online at the National Bureau of Statistics in China website.

IHME's Global Burden of Disease project has the goal of identifying the biggest health problems and quantifying levels and trends in health, and therefore provided the data needed for this study on under-five mortality. GBD data is a compilation of over 2 billion results which are collected and analyzed by over 2,300 research in more than 130 countries. The analysis of all the collected results involve consistent methods are applied to all these results in order to quantify trends in health. In cases where the results from a country are incomplete, they use standardized metrics to estimate. The rigorous methods behind the GBD project and accessible data visualization tools allowed for the use and identification of specific information on under-five mortality in China for this study.

Data from the peer-reviewed literature provided already synthesized tables on relevant information from which adapted tables could be formed for integration into the results section. The main avenues for finding peer-reviewed literature were PubMed, Science direct, Duke Libraries, and search engines such as Google.com. An initial search focused on under-five mortality and related indicators at global scale. The following search restricted to within China only. The combinations of keywords included, but were not restricted to: under-five mortality, infant mortality, mortality gap, child survival, child mortality, neonatal mortality, Yunnan province, Hubei province, and newborn deaths.

The three groups of secondary data sources are all presented differently but the root source of their outputs comes from data within the Chinese surveillance system. For this reason, they complement each other well.

2.3.2 Qualitative Data Collection

Due to the nature of this explanatory study and the interconnectedness of child health and maternal health, the participants for the key informant interviews were selected using purposive sampling. The participants were all maternal and child health care providers and staff. The three occupations selected at each institution were pediatricians, obstetricians/gynecologist, and MCH Directors. The participants either worked at an MCH institution or in the MCH department of a larger health institution. The eligibility criteria for these providers was they must work in MCH and have at least 5 years of experience in MCH. The 5 years of experience criterion was chosen to ensure they had worked in MCH sometime during the Millennium Development Goal era.

The local principal investigator in Yunnan, Prof. Fang Jing, contacted each of the MCH institutions and departments and requested three specific key informants, namely an MCH director, obstetrician/gynecologist, and a pediatrician. In Hubei, the local principal investigator, Prof Xiang repeated the same process. In one case, a special MCH staff was provided as an

additional key informant. Twelve key informant interviews were conducted with a total of 13 key informants. There were 12 interviews because one interview had two informants (KI 005 & 006) interviewed simultaneously. Table 3 (below) displays relevant information about the key informants.

Table 3: Key Informant Interview Participants

Key Informant (KI #)	Gender	Current Job Title	# of years in MCH	Urban or Rural MCH Institution	Audio Recorded?
001	Female	Pediatrician	7	Urban	Yes
002	Female	Obstetrician	23	Urban	Yes
003	Female	MCH Director	20	Urban	Yes
004	Male	Pediatrician	30+	Rural	Yes
005	Female	Obstetrician	31	Rural	Yes
006	Female	Special MCH Staff	9	Rural	Yes
007	Male	MCH Director	17	Rural	Yes
008	Female	MCH Director	24	Urban	Yes
009	Female	Pediatrician	24	Urban	Yes
010	Female	Obstetrician	20+	Urban	No
011	Male	MCH Director	20+	Rural	Yes
012	Male	Pediatrician	20	Rural	Yes
013	Female	Obstetrician	12	Rural	Yes

After recruitment, the key informant interviews took place in a private conference room at the health institution where the key informant worked. In order to maintain confidentiality, the

only individuals present in the conference room during an interview was the graduate student researcher (the interviewer), an undergraduate research assistant for note taking, the bilingual translator, and the key informant. The translator served to translate from English to Chinese for the informant and from Chinese to English for the graduate student researcher conducting the interview. The interviews usually lasted 45 minutes to an hour.

Before each interview started the investigator gave an overview of the project and project aims. After the overview, the informant was presented with the consent form. The consent form was also in Chinese. All informants provided informed consent. Once the informant read and signed the consent, the interview began. The interviews were predominantly administered in Chinese. All interviews were recorded except for one in which the key informant declined audio recording. Key informants were given a small compensation to thank them for volunteering their time.

The interviewer used a semi-structured interview guide allowing for further probing during the interview. The broad topic areas covered in the interview guide were factors related to the decline under-five mortality, their reasoning for the regional disparities in the U5MR, their opinion on best MCH practices and priority areas for child survival.

The interview guide was divided into three main topic areas, namely the current situation of under-five mortality, lessons from the past (MDG era), and future policy implications for the SDG era (Appendix A). The main purpose of the flow of interview guide was to understand the regional disparities in under-five mortality and how the health system can address these disparities for further improving child survival in the SDG era where child mortality is still a priority. Questions in the first topic area elicited a better understanding of the current state of the under-five mortality rate, insight on risk factors for U5M, and reasons for regional disparities from the informant's perspective. The second topic area allowed key informants to draw upon

their job experiences to provide key lessons on what has worked in improving child survival in terms of MCH practices, policies and interventions. The final topic area explored perceptions of informants on priority areas and challenges for the unfinished agenda on improving child survival and reducing child mortality in the SDG era.

2.4 Data Analysis

2.4.1 Quantitative Data Analysis

In order to address the research aim of demonstrating the regional disparities in relevant indicators related to under-five mortality and child survival, quantitative data from secondary sources was used to examine the relationship between socioeconomic and health-system factors and the regional disparities. The main indicators used in this study were under-five mortality rate, per capita income from wages and salaries of urban and rural households, local government expenditure for medical and health care, number of MCH institutions, and the number of MCH personnel. For each of these indicators a time-trend analysis (evolution of trends and patterns over time) was done for each province side by side. Changes and patterns in trends were examined in between each province and in some cases in comparison to the national average trend line. The key factors explaining these changes and regional disparities were identified through the qualitative data and the other previously listed secondary data sources.

2.4.2 Qualitative Data Analysis

For the qualitative portion, 11 audio recordings were transcribed in Chinese by a designated graduated student at Kunming Medical University. Two bilingual undergraduate students from Wuhan University translated the Chinese transcripts into English transcripts. The English transcripts were then analyzed using the framework analysis method.

Due to the explanatory nature of this study and the questions being addressed, the framework method was deemed appropriate for analysis. The framework method is an analytical approach stemming from thematic content analysis. Framework analysis was developed by qualitative researchers at the Social and Community Planning Research Institute in the 1980s. The five key stages of the framework method are familiarization, identifying a thematic framework, indexing, charting, mapping/interpretation. All eleven English transcripts went through these five stages.

In order to ensure rigor in the qualitative component of this study, a reflexive research journal was kept. The purpose of the journal was to allow for reflection on the qualitative data collection process and how my values and views may influence the findings. Reflexivity is awareness of the reciprocal influence of informants and the research on the qualitative research process, and adds credibility to the research.

During familiarization, the first stage of the framework approach, analytic memos were written to facilitate the development of codes and emergent themes relevant to the study aims. In the second stage of the framework method, the codes and emergent themes from the analytical memos were used to identify a thematic framework. The thematic framework was based upon a priori issues and emergent themes from the familiarization process. The themes were defined and the framework refined to make sure the research aims were fully addressed. In this case, the third and fourth stage of indexing and charting happened simultaneously. The thematic framework was applied to all the transcripts and charted out the relevant responses in a matrix on Microsoft excel according to themes across all informants. This process revealed patterns and connections between themes in the thematic framework allowing for mapping and interpretation of the charted data in the final stage to answer relevant research aims. In addition, the health system building

blocks were used to categorize the emergent themes from perspective of informants on “lessons learned” or effective practices for improving child survival in the MDG era.

2.5 Ethical Approval

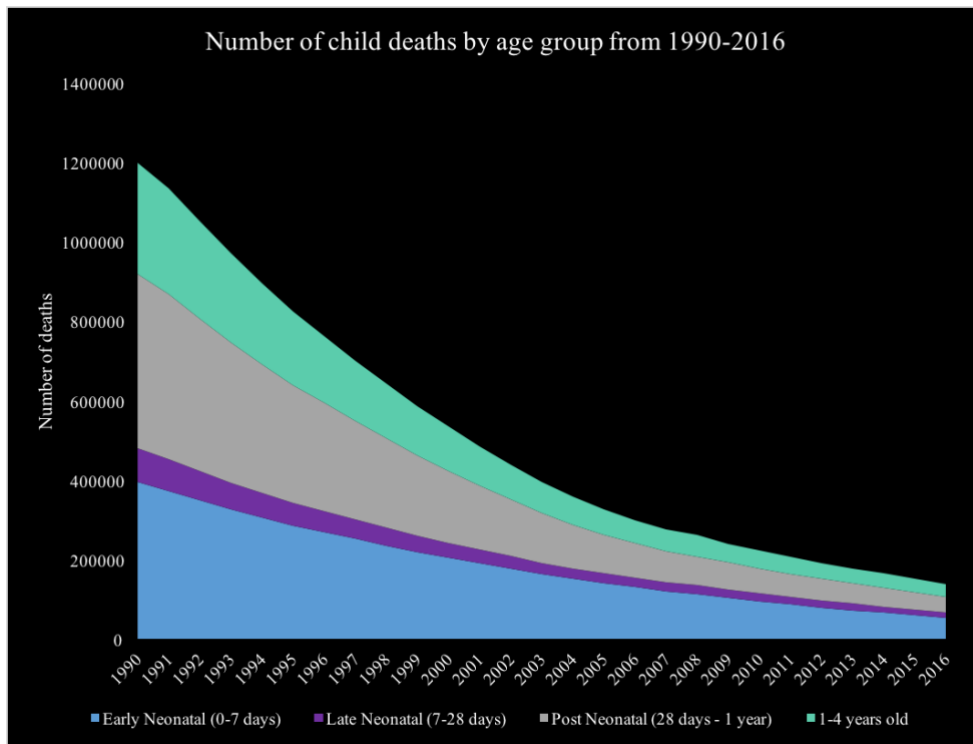
Ethical approval for all study procedures was granted by the Duke University Health System Institutional Review Board on April 6, 2017, under IRB protocol E0097 (Achieving Health SDGs in China: Developing Evidence-Based Policy Options for Action). Ethical approval was not required in the local settings.

3. Results

The results chapter is divided into 4 sections, starting with a brief situation analysis of under-five mortality in China and ending with future priorities for the unfinished agenda on improving child survival. The first section goes from a national to regional level perspective, discussing the findings on the under-five mortality rate in China, including main causes, risk factors, regional differences, and a provincial case study. The second section presents the perspectives of the informants, namely health administrators and practitioners from selected provinces on why regional disparities exist in the main case study indicator, under-five mortality rate. The third section, categorized by the relevant health system building blocks, reports the lessons learned in improving child survival according to the literature and perspectives of the informants. The final section presents the informant's perspectives on future priority areas for moving forward with improving child survival.

3.1 Disparities of the Under-five Mortality Rate in China

At the national level, there was overall decline in the number of deaths in children under five years of age from 1990 to 2013 in China. In the figure below data from the IHME broke down the different categories within children under five years of age. Early neonatal covers the first 7 days after birth. Late neonatal cover from day 7 to day 28 while post neonatal is day 28 to 1 year of age. A steeper decline was seen in deaths of children ages 1-4 compared with deaths of early neonates (Figure 3). Both health administrators and practitioners reported this slower decline in early neonatal deaths by explicitly stating newborn deaths as the largest proportion of under-five deaths.



Source: Adapted from Institute of Health Metrics & Evaluation data

Figure 3: Total number of child deaths by different stages in under-five mortality 1990-2016

When looking past the national level to the regional level, the decline in U5M looked different, specifically highlighting the regional disparities. Data from the peer-reviewed literature showed the annual rate of decline in the U5MR and cause-specific mortality rates as slower in the western region in comparison to other regions (Table 4). In one case, the rate of the decline in the U5MR in western urban areas was almost the same with central urban areas, while a wide gap remained between the western rural areas and central rural areas. This suggests that in addition to the urban-rural gap within regions, there is also a stark rural-rural gap across regions.

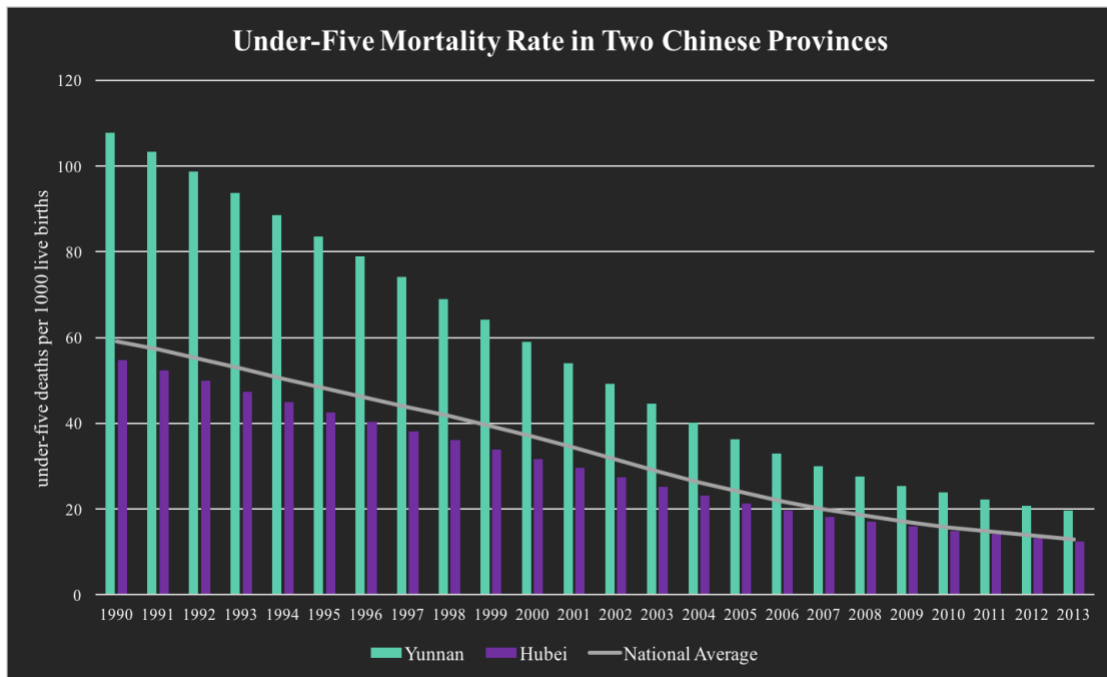
Table 4: National and regional average annual rate of reduction and uncertainty range of all-cause mortality rates and cause-specific mortality rates in children younger than 5 years in China, 1996-2015

	National	Central Region	Western Region
All cause			
Neonatal mortality rate	8.1% (6.4-10.5)	8.9% (7.2-11.3)	6.6% (5.3-8.6)
Infant mortality rate	7.2% (5.3-8.6)	7.7% (6.5-9.8)	6.5% (5.3-8.6)
Under-5 mortality rate	8.2% (6.4-9.7)	8.5% (6.8-10.8)	7.5% (5.8-9.0)
Under-5 mortality rate in urban areas	4.4% (2.8-6.0)	4.1% (2.6-5.8)	4.5% (2.8-6.1)
Under-5 mortality rate in rural areas	7.9% (6.2 - 9.4)	8.6% (6.8-10.0)	6.7% (5.0 - 8.2)
By cause			
Neonatal tetanus	26.4% (22.2-39.3)	34.0% (9.4-42.7)	20.8% (16.4-30.5)
Diarrhea	12.8% (10.1-15.7)	15.5% (11.7-19.9)	11.7% (8.8-14.9)
Pneumonia	11.4% (9.7-13.7)	12.4% (10.5-15.0)	10.3% (8.3-12.8)
Preterm birth complications	6.6% (5.0-9.1)	8.3% (6.6-10.9)	4.5% (2.6-7.2)

*annual rate of reduction (95% uncertainty range)

Source: Adapted from He et al. (2017)

The disparity was not only in the annual rate of decline but also in the under-five mortality rate itself. Considering the apparent regional disparity, Hubei province in the central region and Yunnan province in the western region serve as a case study for the regional disparities in the under-five mortality rate (Figure 4).



Data Source: Developed from National Chinese Statistical Yearbook data

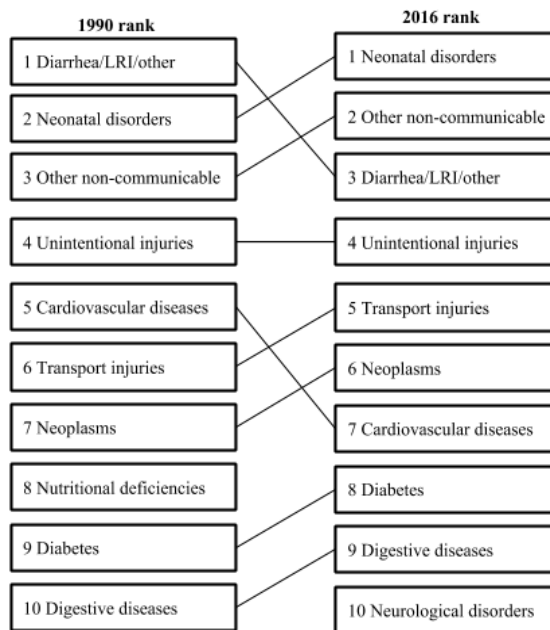
Figure 4: Under Five Mortality Rate in Two Chinese Provinces

There was an overall decline in the U5MR in both provinces, but it took Yunnan 11 years to reach an U5MR of 54.03 in 2001, compared to the starting U5MR of Hubei in 1990 at 54.77. The U5MR in Hubei stayed within range of the national average, while Yunnan maintained a higher U5MR from 1990 to 2013. The provincial U5MR gap seen towards the end of the Millennium Development Goal (MDG) era in China has existed at least since the early 90s and is a clear example of the regional disparities in the U5MR in China.

The disparities in the under-five mortality rate, is also apparent in the causes and risk factors of under-five mortality. At the national level, according to IHME, the top five causes of under five deaths in China have been the same for the past decade with “transport injuries” replacing “cardiovascular diseases” in the top five causes since 2005 (Figure 5). Neonatal disorders, other non-communicable diseases, diarrhea/LRI (lower respiratory infection), unintentional injuries, and transport injuries were all referenced by both health administrators and

practitioners when discussing causes and risk factors of under-five mortality in their area.

Neonatal disorders accounted for the majority of key informant responses for the causes of U5M, while injuries both unintentional and transport accounted for about one-third of informant responses. Overall, neonatal disorders, diarrhea/LRI/other, and unintentional injuries accounted for more than three-fourths of key informant's responses for the causes of U5M, with neonatal disorders in the majority. The descent of diarrhea/LRI/other confirms an area of progress for under-five mortality in China, while rise of neonatal disorders points to children under 1 year of age as an area of concern in under-five mortality. The rise of transport injuries suggests an increasing rate of injuries as a cause of under-five deaths.



China
under 5 years, percent of total death
Source: Adapted from Institute of Health Metrics & Evaluation data

Figure 5: Causes of under-five deaths in China, 1990 and 2016

At the regional level neonatal tetanus as a cause of under-five death had the largest disparity in the annual rate of decline between the central and western region (Table 4). Preterm birth complications had the second largest disparity in annual rate of decline between the two regions. These disparities in the annual rate of decline indicate that causes of under-five deaths play a role in the regional disparities seen in child mortality indicators in China. Furthermore, these two causes fall under the neonatal disorder category which accounted for a majority of informant responses on causes of U5M.

3.2 Main Factors Explaining Regional Disparities

When health administrators and practitioners were asked about their perspectives on what were the reasons for regional disparities in the U5MR a range of themes emerged. The emergent themes were grouped into three large categories, based on conceptual frameworks of determinants of child survival. Table 5 below ranks the three areas in terms of all informant responses. The three main categories were, socioeconomic factors, health system related factors, and perceptions/awareness. We found that across both provinces it was common for MCH directors to discuss cultural and health system related factors as reasons for the disparities, while health practitioners commonly mentioned socioeconomic factors as reasons for the disparities. One of the main divergent qualitative findings was in some cases the responsibility for the disparities was attributed to parents and in some cases the government. Overall the most common finding was socioeconomic factors as the reason for these disparities.

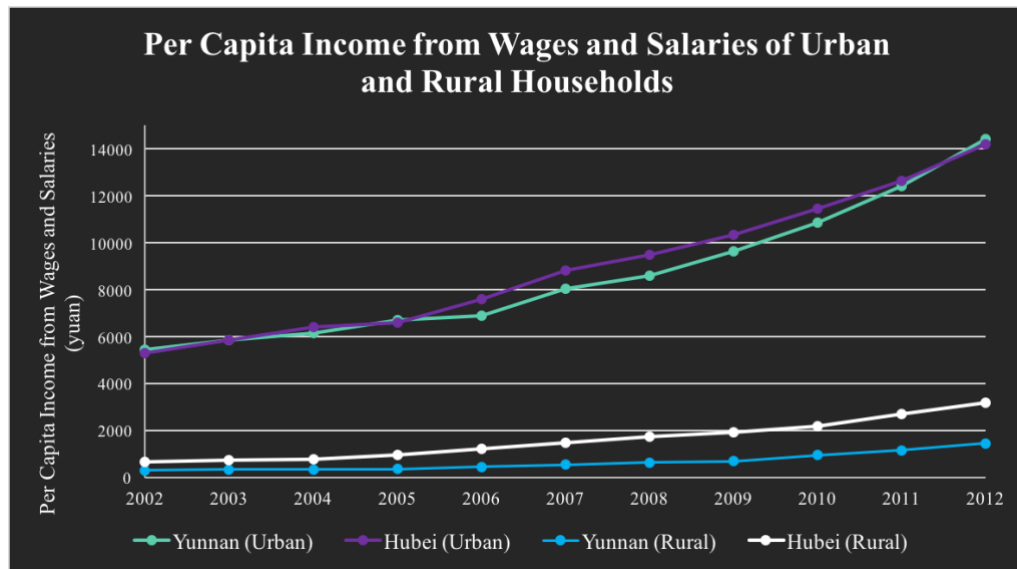
Table 5: Ranking of emergent themes in reasons for regional disparities in the U5MR

Main Themes	Definition	Ranking
Socioeconomic	Parents educational level, economic development in China (including family economic status), and the urban-rural gap	1

Cultural	The perceptions/awareness of parents, community and government about the problem and health promotion about health services and taking care of children.	2
Health-system related	Resource allocation in health financing and the health workforce	3

3.2.1 Socioeconomic factors

In terms of socioeconomic factors, a family’s economic condition was commonly stated as a reason for the regional disparities in addition to the uneven economic development in across China. The ability of the family to afford health care costs depended on their economic status. An MCH Director in an urban institution specified the cost of newborn health care *“In general, the cost of newborn health care is high and some families can’t afford it and will abandon the treatment.”* Per capita income, an indicator of economic status, showed that family economic status also varied depending on the location. In the case of Hubei and Yunnan, Figure 6 shows an ever-widening urban-rural gap within each province from 2002 to 2012. The gap between Hubei’s rural population and Yunnan’s rural population widened overtime, but Hubei’s rural population continued to earn more annually at 3189.8 CNY and Yunnan’s rural population at 1435.9 CNY, less than half of the earnings of their central counterparts in Hubei. On the contrary, as of 2012, Hubei’s urban population at 14191, had a slightly lower per capita income than Yunnan’s urban population at 14408.3. Hubei’s urban population only maintained a higher per capita income than Yunnan’s urban population from 2006 to 2011.



Data Source: Developed from National Chinese Statistical Yearbook data
 *nominal monetary indicator: current exchange rate (1 CNY = 0.16 USD)

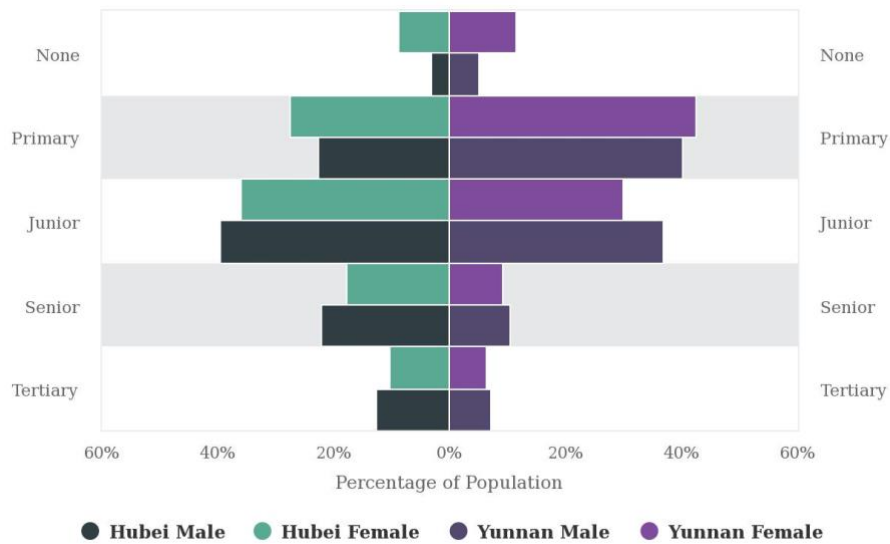
Figure 6: Per capita income from wages and salaries of urban and rural households

When speaking about economic status as a reason for disparities, health administrators and practitioners spoke about affordability which pointed to the financial burden of health care that impacted health-care seeking. In order to provide a comprehensive view of the financial burden besides disparities in household income, another secondary indicator examined was the percent of household expenditure on healthcare. In Hubei the data showed the percent of household expenditure on healthcare in urban households did not vary much from 6:61% in 2004 to 7:10% in 2012, while in rural households the range went form 5.18% in 2004 to 10.34% in 2012. On the other hand, household expenditure on healthcare in rural household in Yunnan went from 4.99% in 2004 to 7.95% in 2012. In terms of financial burden this indicator highlights that other factors are contributing to the disproportionate increase in percent expenditure for healthcare in rural households in both Hubei and Yunnan in comparison to urban households.

Issues within the urban-rural gap were discussed by both health administrators and practitioners in regards to its impact on the regional disparities in the U5MR. The special MCH

staff at the rural institution in Yunnan described geographical differences between urban and rural areas that resulted in differences in causes of under-five deaths. *“In the city, heavy traffic means more car accidents. For drowning, because children in the city have less chance to go to the pond while rural areas have more ponds, drowning happened mostly in rural areas”*. According to both health administrators and practitioners the geographical differences between urban and rural areas spoke to the uneven development across China, therefore leading to differences in mortality rates.

Another common reason for the regional disparities in the U5MR mentioned by both health administrators and practitioners was parent’s educational level. The obstetrician in Yunnan said, *“Parents with better education may pay more attention to the child when they are out, while parents poorly-educated may pay less attention to children. They may look at the phone instead of taking good care of their children. Thus, danger may happen to them.”*, suggesting that a poorly-educated parent is less aware of their child. One indicator related to education level used in the Human Development Index published by the United Nations is called the education index. The education index (EI) is calculated using the “mean years of schooling” and “expected years of schooling”. With 0 meaning “no educational attainment” and 1 being “perfect educational attainment”. In 2014, Hubei had a higher EI than Yunnan, at 0.706 compared to 0.613 [49]. In comparison with the national average for EI, at 0.614, Yunnan was within the national average level while Hubei exceeded the national average [49]. Figure 7 breaks down educational attainment by educational level, showing the stark differences across provinces at the senior and tertiary level. Similar differences were seen in the 2010 census that showed western China to have a higher proportion of illiterate women [50].



CSIS China Power Project | China Statistical Yearbook 2015
 Source: <https://chinapower.csis.org/education-in-china/>

Figure 7: Gender-specific educational attainment between Hubei and Yunnan

3.2.2 Cultural factors

The cultural factors mentioned as reasons for the regional disparities in the U5MR covered the perceptions of parents, community and government in regards to the issue itself and taking care of children. Parental awareness of how to take care of and monitor their children was the most commonly mentioned reason for the regional disparities. Both health administrators and practitioners suggested that parental awareness, a cultural factor, is impacted by the socioeconomic factors previously mentioned, particularly parent’s educational level and economic status. The pediatrician in a rural institution in Hubei said, *“If the family have a bad economic condition, parents will be busy with making money and have less attention on taking care of their children.”* Highlighting a socioeconomic factor as the root problem for “parental awareness”. This informant highlighted who is taking care of the child as a part of parental awareness. Urbanization in China has been found to play a role in who takes care of the child, due

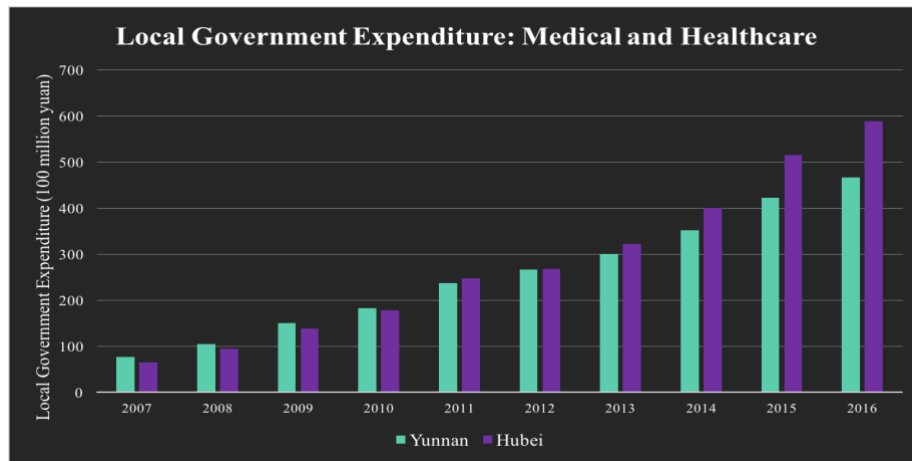
to parents moving to urban areas for work and leaving their children behind without two parents in the household, and possibly leaving them in the care of grandparents [51]. Data based on the 2010 Family Panel Studies underlines the disparity between the urban and rural children in terms of parental presence in the home which can affect parental awareness. Approximately 30% of children in rural areas did not have 2 parents in the house, while in urban areas approximately 20% of children urban areas did not have 2 parents in the house, highlighting a 10% difference in parental presence [51].

The community's/people's awareness of the issue of U5M was briefly highlighted as another reason for the regional disparities. According to one obstetrician in an urban institution in Yunnan, people's awareness of the issue makes them *“more likely to take preventive measures to avoid daily risks.”* Health administrators and practitioners didn't only call out people's awareness of the issue but they also spoke about the governments awareness of the issue, meaning the government's level of attention accounts for the regional disparities in the U5MR. Specifically with an MCH director in Yunnan saying, *“if the government pays more attention to it, the medical conditions, the publicity and the awareness of the residents will improve.”* This quote suggested the government's attention as the root cause and highlighted inadequate health promotion and education as another reason for the regional disparities in U5M. The MCH director went on to say, *“Another reason is publicity at the grassroots level. If the grassroots propaganda is well done, health awareness of the residents will be improved. Then, the awareness of treatment, including hospital delivery will be improved, and the mortality rate will be significantly reduced”*

3.2.3 Health-system related factors

The main factor relevant to the health system as a reason for regional disparities in the U5MR was resource distribution in health financing and the health workforce. When speaking

about resources, health administrators and practitioners in Hubei focused on the regional differences in human and financial resources. An MCH Director from Hubei mentioned, “*We have better resources than the west. For instance, the national government allocates 20 yuan per person to hospitals, and the provincial government provide another 30 Yuan per person, while in the West, the provincial funding may be 10 yuan because of the financial tension in the west. Also, professionals are willing to work in big cities, which causes the shortage of human resources in the west.*” Data on local government expenditure for medical and health care for Yunnan and Hubei, showed Yunnan with a higher health expenditure in 2007 at 77.11 (100 million yuan) and Hubei at 66.11 (100 million yuan). Overtime Hubei’s health expenditure increased and from 2011 onwards Hubei maintained a higher health expenditure than Yunnan. As of 2016 Hubei’s local government expenditure was 588.9 (100 million yuan) and Yunnan’s was 466.98 (100 million yuan) (Figure 8).

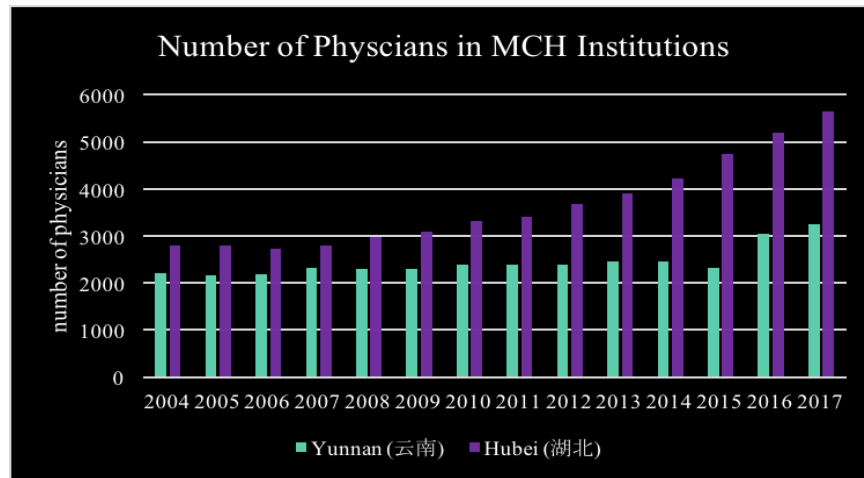


Data Source: Developed from National Chinese Statistical Yearbook data

Figure 8: Local government expenditure: medical healthcare

Furthermore, the desire of professionals to work in big cities contributed to the uneven distribution of health professionals and a “*lack of professionals in the west*”, as stated by an MCH director in Hubei. The lack of professionals was said to impact the quality of care provided in

those regions. Figure 9 displays the consistent increase in physicians in MCH institutions in Hubei, while in the case of Yunnan the number of physicians stay around the same until a spike in into 2016.



Data Source: Developed from National Chinese Statistical Yearbook data

Figure 9: Number of physicians in MCH institutions

Much of the various reasons for the regional disparities in the U5MR presented under the three main themes had some overlap but essentially all had some impact on access to MCH care.

3.3 Lessons Learned: Policies, Practices, & Projects

The drastic overall decline in under-five mortality in China did not occur on its own. Factors within China’s health system influencing the decline included policies, practices, and projects from which lessons can be extracted for continuing the reduction of under-five mortality. For the purpose of this study, “lessons learned” equated to what policies, practices, and projects were effective in terms of improving child survival and reducing under-five mortality. Health administrators and practitioners spoke from their job experience about what they believed was effective. Informant responses ranged from maternal management to health promotion and education. Given that these most of their response were factors within the health system, with one

being outside the health system, the “lessons learned” are discussed in terms of their relevant health system building blocks. Majority of “lessons learned” centered around health service delivery, while the rest of response touched on leadership/governance, health care financing, and health information systems. Specifically, in regards to “lessons learned”, health administrators and practitioners did not mention aspects of the other two building blocks, health workforce and medical products & technologies. They did refer to these two building blocks as areas of improvement/priority moving forward. Therefore, those two building blocks will be discussed in the next section. Figure 10 depicts the overall flow found in this study while matching the emergent themes from informant responses with appropriate health system building blocks. The most common qualitative finding for best practices in both provinces was in terms of maternal management. On the other hand surveillance and reporting was only presented as a best practice by Hubei practitioners and administrators and not by Yunnan practitioners and administrators.

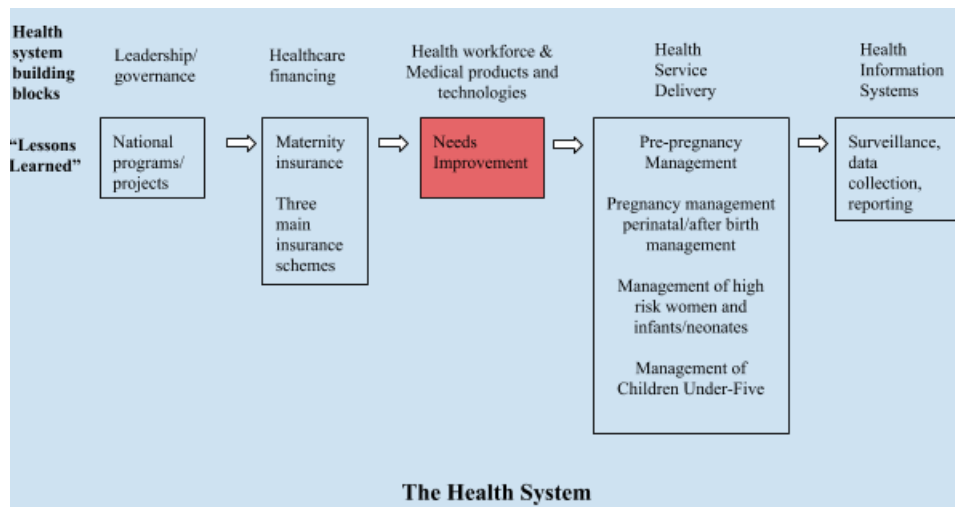


Figure 10: Overall flow of findings

3.3.1 Leadership/governance

Leadership/governance in terms of the health system refers to the policies and strategies put in place in order to improve health outcomes. China’s health system has gone through several

health reforms, the most impactful being the switch from a centralized to decentralized health system in the 1980s. The economic reform of 1978 based on privatization and marketization, led to the decentralization of China's health system and other changes in health policy. Therefore when asked what was effective in improving child survival and reducing under-five mortality, policies and programs were a recurring theme amongst both health administrators and practitioners.

With the decentralization of the health system the changes in health policy brought about a range of national health strategies and policies to target health outcomes. One of the earliest major national programs was the Expanded Program for Immunization (EPI) launched in 1978. The objective of this program was to provide integrated routine immunizations, thereby controlling and preventing vaccine-preventable diseases. Since 2007, the 14 vaccines covered by the EPI are given to all Chinese people free of charge. From 1990 to 1995, we saw the birth of the Diarrheal Disease Control Program and the National Children's Respiratory Infection Program. Both these national programs targeted childhood diseases, and aimed to prevent and manage illness that were major causes of child deaths during that time period.

The focus on MCH continued with the Law on Maternal and Infant Health Care passed in 1994. This law marked the beginning of the decline seen in the under-five mortality rate and other key indicators such as infant mortality rate and maternal mortality rate. This law is also known as the most inclusive law on MCH in China. The objective of the law was essentially to ensure the health of mothers and infants and to make progress in key indicators. A variety of MCH programs/projects were outputs of the efforts to ensure the health of mothers and children. The Program to Reduce Maternal Mortality and Eliminate Neonatal Tetanus was an example brought up as effective. An MCH director in rural institution in Yunnan said, "*the elimination project, which is to reduce the maternal death and eliminate neonatal tetanus. It is a project making a*

great contribution to the reduction of mortality” This program started in 2000 and was also known as the “Safe Motherhood Program”. One of the main objectives was to promote hospital-based deliveries. There was a decline in the maternal and neonatal mortality rates in counties where the program was in place.

In the most recent health reform of 2009, China made progress in five areas. Namely, the establishment of a universal medical insurance system, strengthening the capacity of grassroots health institutions, an equalized basic public health service system, establishment of an essential medicine scheme, and organization of public hospital reform. These national programs and laws are a few of the many examples serving as indicators of leadership/governance within China’s health system that were effective for improving child survival.

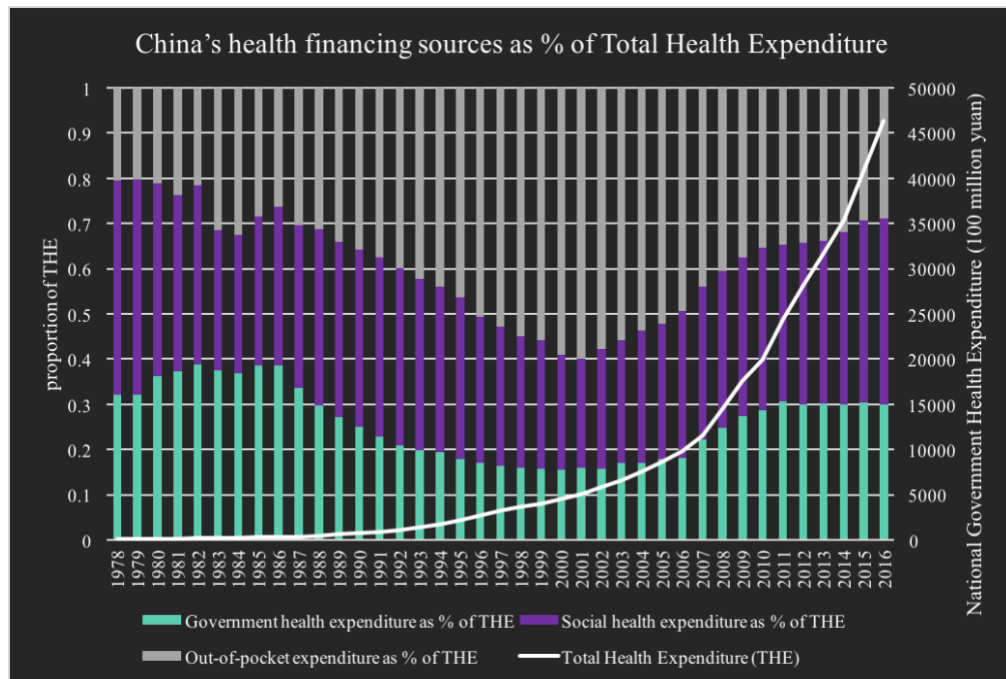
3.3.2 Healthcare financing

The objective of health financing is to provide sufficient funding to cover health needs of all individuals and ensure everyone has access to health care. Healthcare financing in China’s health system has gone through a range of reforms. The current sources of health care financing in China are government health expenditure, social health expenditure (the three public health insurances schemes), and out-of-pocket payments (OOP) (Table 6) [52].

Table 6: Healthcare Financing Sources in China

	Description	% of THE
Government health expenditure (including general taxation)	Spending by all levels of government on public health and medical services, health insurance, administration, and family planning affairs (Tax revenue from taxes on food, drink, accommodation, alcohol, cigarettes, entertainment, gas, etc.)	30.01 %
Social health expenditure	New Rural Cooperative Medical Scheme (NRCMS) Urban Employee Basic Medical Insurance (UEBMI) Urban Residents Basic Medical Insurance (URBMI)	41.21 %
Out of pocket payments (OOP)	Direct payments from individuals for health services at the time of use	28.78 %

These financing sources play a role in the government's investment in health. Figure 11 below shows the government's investment in health, evidenced by trends in national health expenditure from 1978 to 2016. Starting from the central government's control of funding and operating all hospitals and health facilities from the 1950s to the 1980s. With the economic reform of 1978, there was a decentralization of the health system, with national health expenditure at 110.21 (100 million yuan). The 2009 health reform to establish universal health coverage (UHC) led to the current basic medical safety net covering over 95% of China's population, thereby contributing to the apparent reduction in out-of-pocket payments [40]. The success of the establishment of UHC in China was based on the simultaneous investment in two of the three dimensions of UHC, namely population coverage and the types of services covered [40, 53]. It is around this time we see an exponential increase in the government's investment in health, with a 62% increase in expenditure between 2009 and 2016. The reduction in out-of-pocket payments was thanks to the reimbursements provided to citizens.



*nominal price (current exchange rate 1 CNY=\$0.16 USD)
 Data Source: Developed from National Chinese Statistical Yearbook data

Figure 11: China's health financing sources as % of Total Health Expenditure, 1978 - 2016

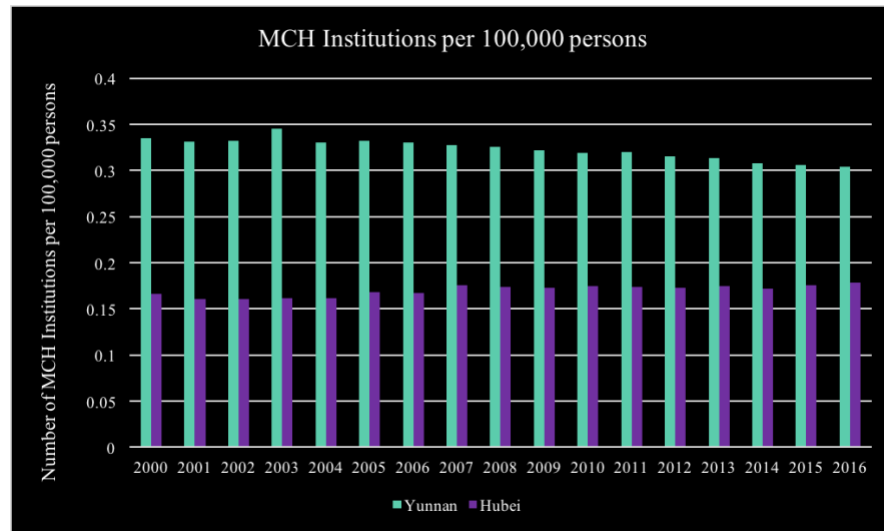
Both health administrators and practitioners spoke of reimbursements when they mentioned “precision poverty alleviation” as effective in improving child survival. Precision poverty alleviation came about in 2013 through President Xi Jinping, in order to better target China’s longstanding efforts to alleviate poverty [54]. An MCH Director in an urban institution in Hubei described precision poverty alleviation as, “*This policy targets poor dwellers in rural areas, and it provides helps to their livelihood, production, such as seeds, fertilizer and pesticide, as well as their health care. These people can get full reimbursement, or at least 95% of the total expenses back. This wide coverage of health insurance is absolutely great to MCH.*” The health care financing behind reimbursement in this policy was seen as effective for MCH through reduction of financial barriers. Maternity insurance was another form of reimbursement mentioned to be effective. Maternity insurance is listed as one of the five social insurance funds

and its target population is urban employees. It covers all maternity-related medical expenses, such as prenatal check-ups, antenatal care, delivery, birth control, and allowances during maternity leave [55].

Reimbursements also exist in the three main health insurance programs in China, namely the New Rural Cooperative Medical Scheme (NRCMS), the Urban Employee Basic Medical Insurance (UEBMI), and the Urban Residents Basic Medical Insurance (URBMI). All three insurance schemes are operated at provincial, prefecture (city) and county levels under a framework set by the central government. The data on inpatient reimbursement rates show gaps between urban (54.6%) and rural (43.7%) and western region (51.2%) and central region (41.2%) [34]. The gaps in reimbursement rates highlights previously mentioned urban-rural differences. The NCMS started in 2003 targets the rural population and rural residents can voluntarily enroll. The UEBMI started in 1998 is mandatory and targets the urban employed population. The URBMI started in 2007 target children, students, elderly, disabled, and other non-working urban residents. For example, the NRCMS allows reimbursement for delivery at a health facility [56]. The maternal care benefit package in the NCMS varies in design and implementation across counties, but the package exists. An MCH Director in a rural institution in Yunnan referred to NCMS when they said, *“the implementation of peasant’s subsidy policy, which allow poor pregnant women being hospitalized free of charge. Not concerning about money, pregnant women are more willing to give delivery in hospitals.”* From the health administrators and practitioner’s perspectives the effectiveness of the insurance program was in reducing the financial burden. These three insurance schemes are a large component for China’s rapid achievement of universal coverage [57].

3.3.3 Health service delivery

As an output of the health system, health service delivery/provision covers many key characteristics. One major indicators of health service delivery are the number of institutions. In this case Figure 12 show the trends in the number of MCH institutions in Hubei and Yunnan per 100000 persons. This indicator was calculated by dividing the resident population by the number of MCH institutions and multiplying by 100,000. The higher density in Yunnan implies other barriers or factors are at play in Yunnan with improving child survival besides the delivery of health services.



Data Source: Developed from National Chinese Statistical Yearbook data

Figure 12: Number of MCH Institutions in Yunnan and Hubei per 10000 persons

Key characteristics of the top ranked theme of maternal management were comprehensiveness, accountability & efficiency, and coordination. Maternal management covered prior to pregnancy, pregnancy management, and high-risk management of mothers and infants. China has a systematic maternal health care system with an increasing rate of systematic maternal management from 77.2% in 2000 to 91.5% in 2015 (Table 7). Table 7 shows an overall

increase in other aspects of maternal management, including prenatal care at the national level and in Hubei and Yunnan. From 2016 to 2017, we see a decrease in the rate of systematic maternal management in Yunnan.

Table 7: Maternal management in China

Year	Rate of Systematic maternal management			Rate of prenatal examination			Rate of postnatal visits		
	National	Hubei	Yunnan	National	Hubei	Yunnan	National	Hubei	Yunnan
2004	76.4	81.32	43.57	89.7	92.76	69.99	85.9	90.88	64.80
2005	76.7	79.92	72.98	89.8	93.27	89.88	86.0	89.88	85.86
2006	76.5	80.62	75.67	89.7	93.07	91.61	85.7	90	87.7
2007	77.32	80.86	77.65	90.91	92.8	92.22	86.72	90.16	88.86
2008	78.1	82.83	79.52	91.0	94.62	93.16	87.0	91.84	89.73
2010	84.1	86.78	84.78	94.1	96.25	95.27	90.8	93.74	93.08
2011	85.2	89.1	87.3	93.7	97.0	96.1	93.7	94.3	94.4
2012	87.6	90.5	90.7	95.0	97.6	96.7	95.0	96.2	95.8
2013	89.5	91.6	93.1	95.6	97.7	96.7	95.6	96.5	97.1
2015	91.5	92.1	93.9	96.5	96.8	98.5	96.5	95.6	97.8
2016		92.6	92.8		96.8	98.3		95.4	97.7
2017		92.8	91.2		97.2	98.5		95.3	97.8

Source: Adapted from China Health and Family Planning Yearbook

When asked about effective practices for improving child survival health practitioners described the process of maternal management. The special MCH staff in Yunnan specifically said, *“Our maternal management are from the discovery of her pregnancy to forty-two days after the delivery. When we find she is pregnant, we have to see if she has any high risk factors, and carry out management according to the early warning scoring if there exists risk factors. According to the early warning scoring, we divided the pregnant women to red, orange, yellow, white, purple, green groups.”* The scoring system was a key component mentioned by health practitioners in Yunnan as beneficial to both the mother and the mother and child, *“The scoring system focuses on maternal safety, but as long as the pregnant women are safe, the children are relatively safe. So this system is helpful for both pregnant women and children.”* This scoring

system spoke to the accountability, efficiency, and coordination that lead to effective maternal management.

These similar characteristics in addition to continuity was seen when management of children under five years of age was discussed. Management for children under-five years of age was mentioned as effective by pediatricians in both Yunnan and Hubei specifically in regards to the free “4-2-1” physical examinations. The 4-2-1 examinations was initiated in 2009 as part of the free national essential public health care package. Table 8 below only lists the MCH related service areas of China’s essential public health care package provided mostly by public primary health centers. Financing of this package is the responsibility of various levels of government [58].

Table 8: Relevant Services list of Chinese national essential public service packages

Item	Target Group	Description
Health education	Residents	Health education materials distribution; health education notice board updates; health counseling services; health education lectures; personalized health education
Planned immunization and vaccination	Children 0-6 years old and other priority population	Manage and implement immunization and vaccination and deal with suspected abnormal cases
Child health management	Children 0-6 years old	Newborn visits; health management for children 0-6 years old
Maternal care management	Pregnant women	Health management for pregnant women at early, middle or late stages,; postnatal visits; checkups after postnatal 42 days
Report infectious disease and sudden public health event	Residents	Risk-manage, discover, register, report and deal with infectious disease and sudden public health event
Health management using Chinese medicine	Permanent residents, 65 years and older + children ages 0-3	Manage the elderly and children health using Chinese medicine

Source: Adapted from LI, M. U. E. T.AI. *Urbanization and Public Health in China*. World Scientific, 2015.

A pediatrician in an urban institution in Yunnan described this aspect of child management as follows: “‘421’ physical examinations means that babies can have four physical examinations for free for their first year of life, two examinations for free before 3 years old and one for between three 3 and 6 years old. The examination can monitor growth of infants and find high-risk infants timely.” These examinations provided a foundation for continuity of care beyond birth for the target under-five population. Furthermore, the free aspect of these examinations and the ability to detect high risk patients covered the comprehensiveness and accessibility of management of children under-five. This same accessibility for children was also seen for women in terms of improved access to MCH services. The most common response amongst health practitioners was the free health management for pregnant women. A pediatrician in Yunnan highlighted the impact of free management on willingness saying, “*Women are willing to come for free check-ups*”. In addition to the absence of a financial cost, one of the core indicators of health service delivery/provision, the number of health facilities was also mentioned. They specifically mentioned the increases in MCH institutions to have improved access to MCH services. An MCH director in an urban institution in Yunnan stated “*The large number of institutions make MCH service more available and convenient.*” Data in Figure 12 supports this statement, showing Yunnan with a higher density of MCH institutions.

According to the service list above for the essential public health care package in China, health education is also a factor under health service delivery. Although not as prevalent amongst health administrators and practitioner’s responses, the theme of health promotion and education was mentioned as an effective practice for improving child survival. From their perspective, health promotion and education on preventing accidents was most effective in improving child survival.

3.3.4 Health informations systems

Health information systems are seen as crucial to the decision making capability at all levels in order to improve health outcomes. Data for these systems is usually collected from hospitals and health facilities. China's health information system in particular, mainly consists of hospital information systems, the public health information system, health insurance information systems, health administrative platforms, and region health information platforms. Surveillance, data collection, and reporting was only mentioned as an effective practice by health administrators and practitioners in Hubei. From their perspective, *“The establishment of records of pregnant women, various levels of security system, tracking from the beginning of pregnancy, and the security network are great to reduce U5MR”*. In addition, the direct reporting system allowed them to track incidence rates and act quickly. The effective tracking provided the opportunity for information-sharing, as referenced by an MCH Director in a rural institution in Hubei, *“Previously, we have national medical conferences a lot as well as MCH working conferences. On these meetings, regions with better MCH as the model, share their experiences with others. Through these communications, we learn from each other, and adopt different policies according to the local situation, and implement relevant practices.”*

3.4 Perceptions of Health Administrators and Practitioners on Future Priority Areas for Child Survival

The health administrators and practitioners' perceptions of what should be prioritized in the Sustainable Development Goal era in regards to improving child survival, converged around two themes, resources and health promotion. In terms of resources, human resources/health workforce was primarily mentioned in addition to other resources such as financial resources and medical equipment. Health promotion referred to prioritizing health promotion and education in order to increase awareness of MCH services and child safety measures. Improving newborn

health was also mentioned as a future priority area. Based on their responses in order to address newborn health there needs to be a focus on the health system priorities detailed below. The most common finding in terms of future priority areas by health administrators and practitioners in Hubei and Yunnan was the health workforce. The only difference was that health practitioners spoke about improving relevant procedures/practices for child health and health professional training, while health administrators focused on health professional training as a future priority. We also found health promotion and education to be commonly mentioned by health practitioners in Yunnan.

3.4.1 Health workforce

The health workforce includes all the workers whose job is to ensure health. Both health administrators and practitioners in Yunnan and Hubei repeatedly highlighted improvement of human resources as a major priority. Improving the uneven distribution of human resources was said to be effective for lowering the U5MR. The shortage of pediatricians in China was repeatedly mentioned. A pediatrician in Yunnan stated, *“To satisfy the demand of medical resources. At present, the lack of doctors and equipment in both pediatrics and neonatal department is really a key concern.”* Tackling the shortage of doctors was suggested to open the door for the another priority area, training of health professionals. Specifically saying that, *“For primary hospitals like us, a sufficient number of doctors is the basis for the improvement of our professional’s skills. Now the main problem is the lack of doctors.”* Training of health professionals was said to be necessary for improvement of their skills and medical techniques. A common reference for training of health professions was the idea of “self-training” and “roll-down training”. An obstetrician in Yunnan said, *“we need to learn more knowledge of new high-risk symptoms and strengthen self-training to find new working methods. Then, we are responsible for training and supervision of the whole district. We should help them renew*

medical knowledge and improve skills.” Improving the skills of health professionals included targeting the procedures they put into practice. Health administrators and practitioners highlighted the improvement of procedures such as early detection of high risk factors, emergency transfer system, and feedback to the government. These procedures were highlighted in terms of their responsibilities as providers in improving child survival. A pediatrician in Hubei said, *“As a pediatrician, the first thing to do is preventing the occurrence of some critical situations, and identifying risks as early as possible”*.

3.4.2 Other resources

The two other resources mentioned as priority areas were financial resources and medical equipment. Specifically stating the “guarantee of financial sources”. An example being, *“Recently, fees related to delivery have been set upper limits. Most pregnant women do not need to pay themselves, and the hospital cannot earn much money from the patients. So the funding is the most important aspect”*. This statement reiterated the importance of addressing the financial burden associated with health care, and the importance of funding for hospitals to continue to operate and provide quality care. In regards to the financial burden, an MCH director in Hubei discussed a pilot *“totally free basic public health service”* where pregnancy delivery was free of charge, and specifically stated, *“a good policy really works to lower U5MR”*. This MCH director suggested upon the success of pilot, the government should roll this pilot public health initiative across China. This suggestion will require more financial resources. In regards to medical equipment, a pediatrician in Yunnan mentioned the lack of equipment in pediatric and neonatal department as a major concern. Therefore, reiterating the priority for newborn care.

3.4.3 Health promotion and education

Health promotion and education was a two-fold priority. Health practitioners in Yunnan and Hubei talked about focusing on pregnant mothers, to increase their awareness about free health services and how to take care of themselves and their babies. Strengthening health promotion and education in this sense was, “*making it known to everyone that we can provide health service during pregnancy for free for everyone*”. On the other side of awareness, health practitioners talked about the importance of educating parents/guardians about safety and protection of their children, stating that, “*parental monitoring plays an important role in avoiding risks in their daily life.*” A pediatrician in a rural institution in Hubei went further to tie it back to the causes and risk factors of U5M saying, “*Socially, publicity and education should be strengthened, especially for the education of safety awareness. Because unintentional injuries are causes and main risk factors of under-five mortality.*” The connection of health promotion and education with child survival was focused on prevention.

4. Discussion

In this study we explored factors explaining the regional disparities in the U5MR in China, the lessons learned in improving child survival, and future health system priority areas for improving child survival. Our results show that the key factors that appear to explain the regional disparities in U5M were uneven economic development, distribution of human and financial resources, and caregiver-related. In terms of lessons learned, our results show healthcare financing under the health system reform and vertical programming for MCH as effective in improving child survival. Lastly, our findings point to the health workforce and health promotion and education as future priority areas for improving child survival and reducing child health disparities.

4.1 Factors Explaining Regional Disparities in the U5MR

4.1.1 Uneven economic development

At the macro level, our findings that uneven economic development is a factor explaining the regional disparities in the U5MR is supported by the widening gap between the per capita income of urban and rural households. Our results evidence this gap with a 75% difference between urban and rural household's incomes in Hubei and Yunnan and a 50% difference between rural household in Yunnan and their Hubei counterparts. Considering the known impact of economic development on health outcomes, this was not a surprising explanation. Furthermore, a study on Yunnan province found per capita income to be negatively associated with child mortality [59]. The negative association of per capita income with child mortality coupled with the disparity between urban and rural per capita income could explain the disparity in the U5MR in western and central parts of China. Some researchers argue that urban-rural income inequity can impact neonatal death by lowered maternal education, reduced access to

prenatal care, and reduced quality of medical care [60]. The disparities in the per capita income levels could have translated to differences in accessing healthcare. As presented in our findings, parent's ability to seek treatment for their child depended upon their "economic condition", which determined what they could afford. When treatment costs exceeded what they could afford parents abandoned treatment. Cost of treatment only becomes a barrier when families have a lower economic status, as evidenced by their income level. Higher household income levels can lead to lower under-five mortality through other determinants of child mortality, as referenced in the conceptual framework on child survival (Figure 2). Generally speaking, an individual's probability of disease and premature death is lowered as the individual's income gets higher [61,62].

Surprisingly, in addition to the urban-rural income inequity, we also found a widening gap between rural per capita incomes between the two provinces, suggesting that there might be rural-specific factors to consider across regions when exploring regional disparities in the U5MR. Our findings on the disparities in per capita income between urban and rural areas highlights geographical differences as an important aspect when discussing regional disparities. Furthermore, our quantitative findings on percent of household expenditure for health similarly point to possible rural-specific factors in terms of the urban-rural disparities in household spending on healthcare. Therefor highlighting the disproportionate financial burden on service users in urban and rural areas in China. Furthermore, research published in the WHO bulletin on catastrophic health expenditure (CHE) in China confirms that the disparities are at the urban-rural level rather than across regions, with CHE distribution being higher in rural areas for various members of household including those under the age of five [92]. This further confirms the uneven financial healthcare burden placed on services users.

Surprisingly, in addition to the urban-rural income inequity, we also found a widening gap between rural per capita incomes between the two provinces, suggesting that there might be rural-specific factors to consider across regions when exploring regional disparities in the U5MR. Our findings on the disparities in per capita income between urban and rural areas highlights geographical differences as an important aspect when discussing regional disparities. Our qualitative findings suggest that geographical differences contribute to the disparities in the cause-specific U5M rates of decline indicated in the results section. Drowning as a cause of under-five death is more prevalent in rural areas than in urban areas. Similarly, several studies have confirmed the higher occurrence of drowning and exposure to water sources in rural areas in China [63,64,65]. Along with other studies [6,12,13], our findings on uneven economic development as a factor explaining the regional disparities sheds light on how far behind the western region of China is in comparison to the central region, and the importance of identifying and targeting barriers to accessing health care within the urban-rural gap such as cost of care, particularly in low income rural populations.

4.1.2 Distribution of human and financial resources

At the health system level, our findings that distribution of human and financial resources explains the regional disparities in the U5MR is supported by the variation in MCH human resources and local government health expenditure between the two provinces. Based on the previously discussed factor, we expected a consistently increasing disparity in local government health expenditure between the two provinces. Surprisingly, our findings show that Yunnan's local government health expenditure was higher than Hubei's until 2010, when it reversed and the increasing disparity in health expenditure began. The reversal seems to have occurred after the 2009 health system reforms and indicated substantial increases in financial resources for Hubei in the central region, compared to Yunnan province in the west. Prior to 2010, when Yunnan had a

higher health expenditure, the regional disparity in the U5MR between Yunnan and Hubei still existed, suggesting that other factors in addition to health expenditure contributed to the regional disparity in the U5MR. Health expenditure is a demonstrator of the level of government attention to financing health care services, which depending on how it is provided (via service providers) and the quality thereof is a vital contributor to health outcomes. Reductions in global health spending in the European Union countries was found to be significantly associated with increases in maternal mortality [66]. Similarly, studies in Europe and sub-Saharan Africa have found health expenditure to be a determinant of maternal mortality [67,68], with a known association between maternal mortality and infant mortality. Furthermore, the adapted conceptual framework from Mosley and Chen lists local government expenditure as a determinant of child survival. As a determinant of child survival, variations in the health expenditure will have an impact on the health outcomes such as the U5MR. Moreover, increases in government expenditure are an important aspect of achieving health results [69]. Therefore, the modest increases in Yunnan's health expenditure in comparison to the substantial increases in Hubei's health could explain the persistent regional disparities in the U5MR.

The second health system factor we found to explain the regional disparities was the distribution of human resources. The human resources network has an impact on population health. The first nationwide investigation of MCH human resources in China found an uneven distribution in the quantity and capacity of MCH human resources [70]. Similarly, our qualitative findings emphasized the shortage of doctors, particularly in the pediatric and neonatal departments and the uneven distribution of doctors overall. Doctors were more willing to work in urban areas rather than rural areas thereby leading to the uneven distribution of human resources and further impacting the worker density. Worker density has been found to be negatively associated with the under-five mortality rate, hence an uneven distribution in human resources

explains the disparities seen in the U5MR in China [28]. The data on the number of physicians in MCH institutions presented in the results section further confirms studies that have highlighted the distribution of health professionals as a urban-rural issue, with the rural areas at a distributional disadvantage [40,71]. Our findings on human and resource distribution indicate that factors influencing health professional's decisions to work in urban areas are also contributors to the regional disparities in the U5MR. Additionally, the findings on financial resources highlights the importance of ensuring the increases in health expenditure are suitable for achieving health results, such as reducing disparities in child health indicators.

4.1.3 Caregiver-related factors

The last factor we found to explain the regional disparities in the U5MR was caregiver-related, in terms of individuals who take care of the children and parent's ability to take preventive measures to protect their child and. Caregiving is influenced by who is taking care of the child. In the wake of urbanization, studies have shown children in rural areas are at a disadvantage when it comes to parental presence in the home and who takes care of the child [51]. This present the concept of children left-behind as area of concern when looking at regional disparities. A UNICEF report from 2010 found 61 million children left behind in rural parts of China [51]. Moreover, caregivers and parents are responsible for taking preventative measures to protect the child. This aligns with the fact that unintentional injuries are in the top five causes of under-five deaths in China. Our qualitative findings indicated that the ability of parents to pay attention to their children and ensure their safety depended upon their economic condition and parent's educational level. Hence suggesting that poorer families were more focused on making money than on taking care of their children. The concept of a family's economic condition impacting how children are taken care of reveals the disparities that could result in child survival in China, especially knowing the uneven economic development. Furthermore, the association

between parental education and child health outcomes, particularly the mother's educational level, is frequently seen in the literature. Similarly, findings from a study on sub-Saharan African countries found educational attainment as a determinant of child mortality, showing that an increase in maternal education leads to increased awareness of child illnesses, best health practices, and availability of services [72]. Therefore, the domino effect between economic condition, educational level/attainment and parental awareness could explain the regional disparities seen in the U5MR. Our findings placed sufficient blame on parent's for the disparities in the U5MR, but not so much on the government. A possible explanation for this "blame" is the perspective from which health administrators and practitioners spoke. As implementers of the health system, the tendency could be to point outwards at the parents and caregivers.

In addition, in terms of cultural factors impacting child health, the global literature points to cultural practices and ethnic and religious beliefs of parents impacting health-care seeking behaviors [93,94,95]. Although our qualitative findings did not emphasize ethnic differences, at the global level those in ethnic minorities are seen to be at a disadvantage in terms of health outcomes due to economic status, educational attainment, geographic location etc. There has not been much research on child mortality across the various nationalities in China, but one study in Yunnan found large disparities between the Han and minority nationalities in terms of key health indicators for child mortality such as the mortality rate for under age 1[59]. A recent systematic review in the Lancet recognized that ethnic minority populations in Western China are behind in terms of MCH outcomes and aimed to explore ethnicity's impact on MCH outcomes. The review concluded that there is a lack of research exploring the disparities amongst ethnic minority populations in China but highlighted the need to use primary data from national surveys to further explore variations between ethnic groups [95].

4.2 Lessons Learned: Experiences/Best Practices

Our findings, similar to other studies indicate that healthcare financing prior to the 2009 health reform with public health insurance schemes, NRCMS and UEBMI, starting in 1998 and 2003 respectively, addressed the financial burden of health care [23]. Specifically, researchers point to the improvements in MCH funding as role player in women and children health protection [23]. The 2009 reform aimed to establish UHC in China, starting with providing equal access to a basic medical insurance system for urban and rural residents [23]. This led to the government's increased public investment in the three main health insurance schemes [73]. Our qualitative findings suggest that the efforts to relieve financial burden of MCH care in particular were most effective. Similarly, researchers have argued the 2009 health reform played an instrumental role in protecting women's and children's health and promoting health equality [23]. Financing for MCH care under the NRCMS reimbursement has covered MCH services, and some researchers have credited the reductions in IMR, U5MR, and MMR to financing efforts such as the NRCMS [23]. Additionally, another study found that central and local government subsidies for the URBMI scheme covered 56% of financing costs for children [74]. All three insurance schemes combined have contributed to the medical safety net covering 95% of China's population, which could indirectly explain the overall decrease in the U5MR [74]. On the other hand, our results show disparities in the reimbursement rate across the three insurance schemes, which other study findings have claimed to suggest differences in insurance benefits and affordability of health services among the different groups each insurance package covers [40]. The Chinese government recently proposed consolidation of these insurance schemes as an avenue to address the aforementioned differences. Recent study findings of a pilot consolidation in Suzhou, China revealed that the differences in insurance schemes still persist [75]. These

finding highlights the possible impact of the overlooked inequalities associated with these insurance schemes on health outcomes.

The aforementioned efforts reduced out-of-pocket expenses, which in the first wave of reforms in China were linked to impoverishment. Acknowledging the link between healthcare expenses and impoverishment was the first step in the Chinese government's attempt to reduce the financial burden associated with health care [40]. Our findings indicate that the reduction of the financial burden associated with MCH care led to the willingness of women to deliver in hospitals. Similar findings show financial cost of healthcare, broken down into direct, indirect, and opportunity costs, as one of the major barriers to seeking necessary care especially in poor populations [76]. A study in a rural area in Bangladesh found that MCH care costs, specifically delivery in a public comprehensive obstetric facility was estimated to be almost 50% of their husband's annual income [77]. Therefore, addressing barriers to MCH care in the most disadvantaged populations is a recommendation to be considered in China.

In terms of health service delivery, our findings suggested that strict maternal management was effective in improving child survival in China. Our results show that the detailed high risk scoring system and extension of maternal management past the neonatal period was essential to the mother's safety which impacted the child's safety. Other studies have also highlighted the importance of maternal health care on child survival, a study in Azerbaijan found that probability of child survival increases by 18% for women who delivered in healthcare facilities [78]. Furthermore, on study found that the reduction in maternal mortality, was due to an increase in institutional births [79]. Since institutional births increases the chances of the survival and intersects with strict maternal management, the improvement in child survival due to maternal management in China is justified. Additionally, the extensive maternal management seen in China falls under the concept of a continuum care which researchers have emphasized as

the avenue to reduce 6 million deaths of children between ages 1 and 5 and 4 million neonatal deaths [80,81,82].

Overall our findings emphasized strict maternal management and health care financing within the 2009 health reform as effective practices that improved child survival in China. These findings highlight a few lessons. First, specifically targeting barriers to MCH care in the most disadvantaged population could prove effective in impacting MCH indicators. Secondly, a rapid increase in insurance coverage showing reductions in MCH indicators overall, does not equate to equitable quality and affordability for all insured groups. Lastly, the further of programs or interventions for maternal, neonatal, and child health have the potential to further improve child survival. Applying these lessons at the regional level and across counties in China will be crucial to reducing the disparities in child health indicators such as under-five mortality.

4.3 Future Priority Areas

Our qualitative findings revealed health workforce as a future priority area for child survival. Numerous aspects were highlighted under health workforce but the primary focus was the shortage of doctors, especially in the pediatric and neonatal departments. When looking at the health workforce in China, our findings were consistent with other studies revealing the shortage of doctors as an area of concern. An insufficient workforce cripples the quality, availability, and utilization of services for pregnant women and children [83]. In China's case pediatricians have been shown to have the largest shortage which researchers have argued is due to removal of the pediatric specialty in medical schools, increased pressure from parents on pediatricians, and the insufficient compensation of pediatricians [84]. The shortage of doctors connects with the uneven human resource distribution discussed earlier, highlighting that the shortage of doctors is concentrated in rural areas. Similarly, one study found that rural areas have fewer pediatricians

and skilled neonatal care staff. They argued that the shortage in rural areas hindered the reduction of the disparities in IMR between urban and rural areas [23]. These findings emphasize the need to target rural areas with interventions and programs for bolstering the pediatric and neonatal workforce. Interventions that could work in China include, establishing a medical school for producing rural doctors, incentives for doctors who agree to work in rural areas, and medical school admission of students with a rural background [71].

The second priority area revealed in our findings was health promotion and education. The idea of health promotion and education is to change behavior and improve health status. It also emphasizes the many determinants of health within and outside the health sector, and maternal education has been found to be a determinant of child survival (Figure 2). A researcher developed a framework for childhood health promotion and claimed that focusing health promotion on children under-five years of age is important for reduction in the burden of disease at the population level [89]. At the international level, according to the WHO recommended health promotion interventions such as community mobilization with women's groups to identify priority actions and organize activities for before, during, and after birth [90]. In addition, research studies have shown the influence of grassroots level actors such as community health workers (CHWs) on health promotion and education in MCH. For example, a systematic review on CHWs in low and middle income countries found that CHWs were effective at delivering short target messages for health promotion and education and malaria prevention [91].

We also found the focus of this priority was targeting the main causes and risk factors of under-five mortality such as unintentional injuries, the 4th leading cause of under-five deaths in China. Increasing awareness about free public services and preventive measures was the main suggestion. An argument supporting this priority was made by a US researcher stating that increasing the availability of information on how to protect children and ensure their safety led to

the reduction in unintentional injuries and child mortality in the United States [85]. Similarly, the importance of raising awareness around preventive measures for children is evidenced by statistics on unintentional injuries in China [86,87]. Studies have found the increasing trend in child injury mortality is driven by rural areas [87]. Therefore, a targeted approach to addressing the preventable injury-related causes and risk factors of under-five mortality in rural populations is necessary. As evidence by one study in Hunan province, the manifestation of this approach depends on the establishment of a system for surveillance of risk factors to aid in the development of an effective evidence-based approach.

In order to focus on the aforementioned priority areas, a supportive environment is necessary within China's health system. A supportive environment is characterized by specific policies and strategies targeting priority areas. In Malawi, in order to address the human resource crisis mostly as a result of the acute shortage of professional workers in the public sector they implemented the Emergency Human Resource Plan. This plan was led by the Ministry of Health and managed through a sector-wide approach, which due to the level of collaboration was found to be effective in Malawi [88]. Over the course of five years, Malawi saw a 53% increase in the total number of professional health workers. Some of the factors creating the supportive environment in Malawi's success in HRH were government commitment, multi sectoral collaboration, donor willingness, consistent communication with stakeholders, and an integrated and well-functioning human resource management system. It is clear utilization of existing infrastructures is essential in creating the supportive environment for emphasizing these priority areas.

Overall, prioritizing the health workforce and health promotion and education is should not only be up to the government. The prioritization process should be "government-led, whole society-participated manner" [44].

4.4 Future Research

The findings of this research study address the regional disparities in the U5MR from a health system perspective, hence shedding light on three areas for further research. First, comparison of the U5MR between cities in different regions across china, particularly rural areas will aid in identifying the differences in factors associated with improving child survival on one side of the disparity. Secondly, exploring whether there are disparities in child health outcomes due to the differences in insurance scheme benefits is essential to ensuring equity in affordability and coverage of services. Lastly, determining what factors explain the regional disparities from a population perspective will provide insight for an inclusive approach to improving child survival in China.

4.5 Limitations

One of the major limitations in this study was the language barrier between the interviewer and the interviewee. Although the language barrier was mediated through the use of an interpreter, in some instances the ability to further probe was limited. The language barrier might have affected the analysis and interpretation of the results, particularly in process of transcription and translation. The sample size of the informants is small and may not be representative of all the providers and administrators in Hubei and Yunnan and therefore limits the generalizability of study results. The level at which interviews were conducted might have limited the findings to only perspectives of people at the implementer stage of the health system versus interviewing at the national level with policy makers and other key stakeholders or even at the grassroots level within the population.

5. Conclusion

In summary, this study shows that in order to improve child survival, factors within the health system and other factors outside the health system impacting child health must be targeted.

Factors within the health system impacting child health were more apparent, particularly the distribution of human and financial resources. Financial sources in China such as, the three social health insurance schemes and government subsidies for essential services in the public service package are important due to the ability to reduce out-of-pocket expenses and improve access to and affordability of health services. The stagnation in the number of physicians in MCH institutions in the west and greater increase of financial and human resources in central region could result in differences in access to healthcare for children across regions. These differences could be in the options of doctors for care-seeking and the cost of health care, causing variations within child health indicators and outcomes across regions.

In addition to the health system, socioeconomic and cultural factors also impact child health and emphasizes the great disadvantage or children in rural areas part of China, especially in the western region. The disparities in the capacity to pay for the healthcare between urban and rural households can impact the abandonment of child health care health practitioners spoke about. This points to possible disparities in health care-seeking across children in urban and rural areas in China. Moreover, due to urbanization, disparities between children in urban areas versus those in rural areas have been further perpetuated. Children left behind in rural areas in with caregivers presents a possible increase in daily risks factors such as unintentional injuries a major cause of under-five deaths in China. Hence, children left behind in rural areas at a greater disadvantage than their urban counterparts.

In order to address these factors which serve as barriers to child health and survival understanding the lessons from overall improvement of health financing in China is pertinent. In spite of the many efforts of health reform made to increase government subsidies on health and to reduce financial burden for the Chinese population, OOP still contributed one-third of THE, is a potential barrier to accessing needed healthcare especially in improving child survival where financial burden is an important consideration.

From the perspective of health administrators and practitioners in this study, there seems to be many barriers to bolstering the workforce in pediatric and neonatal departments, the most significant being the lack of doctors. The potential impact of lack of doctors on the quality of care provided is reason to address this barrier and other barriers such as lack of health care funding. Moreover, the recent two-child policy could increase burden on the current pediatric workforce. If there aren't enough doctors to provide needed care, the child survival won't be improved even all barriers to access on the demand side have been removed. Additionally, in terms of health promotion and education as a future priority, sharing the responsibility for health promotion and education across the education and health sector could prove beneficial in targeting the causes and risk factors of child mortality impacted by factors within and outside the health system.

To address the major challenge of health workforce shortage, policy recommendation would be to bolster the pediatric and neonatal workforce in two perspectives. At the medical educational level, it is important to allocate and provide funding for a certain number of spots for individuals who will specialize in pediatrics in rural areas and requiring those individuals to serve in that specialty and area for a certain period of time. Additionally, the NHFPC should mobilize current physicians and those in the medical educational sector to develop sustainable incentive options for retaining and bringing health practitioners into rural areas. These options must definitely include an increase in compensation for health practitioners working in rural areas. In

regards to children left behind in rural areas, a recommendation would be for the governments to require grassroots level institutions to provide targeted free education for caregivers of left-behind children. Targeted caregiver education possibly involving social workers will address taking preventative measure against daily risks for children and advance health promotion and education for child health in populations who are at disadvantage.

Due to the clear financial burden of healthcare in rural populations in the Western region, it is high time to adjust the distribution of investments in health care across regions and at the urban-rural level. Particularly, in terms of social health expenditure, adjusting factors such as the reimbursement rates between urban and rural areas to make them more equitable for rural populations which are currently at a disadvantage. This could reduce the urban-rural disparities in reimbursements and influence progress towards equitable financial protection of the Chinese population. Overall the end goal is to help achieve health equity across regions in China, especially in terms of impacting child survival.

Appendix A

Chinese Consent Form for Key Informants

重要知情人知情同意书

重要知情人知情同意书

介绍：

您好我的名字是_____。

我正在与美国杜克大学的唐澜澜博士合作，就在中国实现健康SDG进行研究：制定循证行动政策选择。该研究由比尔和梅琳达·盖茨基金会赞助。

收集的所有信息将仅用于研究目的。研究是自愿的。

当您阅读这份同意书时，请花一点时间决定您是否参加。

请让我为您解释您不清楚的任何地方。研究的目的，程序，风险和收益如下所述。

研究小组将为您提供此表格的副本。重要的是您需要知道：

- 您的参与完全是自愿的;
- 您可以随时决定不参加或退出研究。

学习目的：

研究的目的是了解省份内实现联合国可持续发展目标4的差距，以及中国卫生系统如何解决实现这些差距。

谁将参加这项研究，以及这项研究将持续多久？

中国两省（云南，湖北）一共约15- 20名重要知情人士将参与本次研究。我们正在和不同级别的妇幼保健机构的健康服务提供者进行交流：包括来自政府的医院官员，包括：受过专业训练的医生，护士，临床干员或医院负责人。每个采访将持续约60分钟。您的参与将在讨论结束后结束。

程序：

如果您选择参加这项研究，我们将向您询问一些与您在五岁以下儿童和儿童保健服务方面的角色和意见有关的问题。您的回复将被录音。如果不想录制，请通知我。录音只是笔记的备份。我们希望您愿意回答我们的问题，但请不要分享任何您不希望别人重复的内容。

补偿：

这项研究没有直接的补偿。然而，您提供的信息将有助于我们改善中国在实现健康相关联合国可持续发展目标方面的战略。

保密：

您的个人信息，例如姓名，地址或其他与您和您的家人有关的身份信息不会被注意或记录。采访录音将在简要的自我介绍后开始。所有收集到的信息将被保密，只有与本研究相关的授权人员可以访问。在本研究的任何出版物中，您的身份都不会被识别。

授权人员（包括杜克大学，昆山大学，武汉大学，复旦大学，昆明医科大学，刚果民主共和国和发改委的研究人员）是本研究的主要研究者，他们必须在面试前签署保密协议并接受机构审查委员会的相关培训。

自愿参与/退出权：

参与本次研究完全遵循自愿原则。您可以选择在采访过程中随时停止参加。如果您选择停止参加，我们会使用您已经提供给我们信息。但是，一旦你停止参加，我们将不会收集任何新的相关信息。

如果我有任何疑问，我该打电话给谁？

关于这项研究自身的问题，或者如果您对研究有任何看法，疑问或建议，请联系杜克大学的汤胜兰教授（电话1-（919） - 681-8857或复旦大学的应晓华教授（电话号码86-（21） - 54237283）。

如果您决定停止参加，请通过电子邮件或书面形式与汤胜兰教授联系，让他知道您将停止参加。他的电子邮箱联系方式是Shenglan.tang@duke.edu。

关于您作为研究参与者的权利的问题或与研究有关的问题或疑虑联系杜克大学伦理委员会919-684-3030和campusirb@duke.edu。

志愿者协议

我证明，我已经了解了参与此研究的相关性质和目的，潜在的好处和可能的风险，并获得知情同意书。

_____	_____
研究参与者	日期
_____	_____
获得同意者签名	日期

Appendix B

Content of Key Informant Interview Guide

The decline in U5M

- Main causes risk factors of U5M
- Regional disparities in the U5MR
- Use of data to reduce U5M

Lessons from the past (MDG Era)

- Effective policies, practices, and interventions
- Quality of care and service provision
- 2009 Health reforms
- Primary care system in China

Future (SDG era) policy implications

- Potential challenges
 - Two-child policy
 - Provider role in improving child survival
 - Priority areas
-

Appendix C

Key Informant Interview Guide for MCH Service Providers

Introduction/Purpose of KII

My name is Chisom Nwaneri and I am currently a Master’s student of Dr. Shenglan Tang, the Executive Director for the Global Health program at Duke Kunshan University in the Jiangsu, Province.

I am here today to discuss under-five mortality in regards to maternal and child health services, and how the progress made with the United Nations’ previous Millennium Development Goals (MDGs) can continue in regards to the health-related Sustainable Development Goals (SDGs). For this study I will focus on MDG 4, which was to reduce under-five mortality worldwide by two-thirds between 1990 and 2015. China achieved this goal at the national level nine years ahead of the 2015 deadline. In 2015 China was one of the countries that adopted the new Sustainable Development Goals set to be achieved by 2030. The new SDGs include ending preventable deaths of children under five years of age by 2030. We would like to hear your views about the current situation, the policies, achievements and challenges in regards to further reducing under-five mortality and the regional disparities that exist in the under-five mortality rate in China. For the purpose of this interview, the phrase “improving child survival” is synonymous with “reducing under-five mortality”.

For the purposes of confidentiality, we will not record your self-introduction. I will only write down your position title, name of the MCH institution you work for, and your years of work experience in MCH, instead of name or other personal information. I will now start the audio-recording which was previously described during the consent process.

Information to be recorded:

- Job Position Title
- Years working in Maternal and Child Health

I. The Decline in U5MR (Present)

- 1. Can you briefly describe your educational background and your work experience in maternal and child health?**
- 2. Briefly describe the patient population you generally work with.** (tips: urban/rural, insurance type, resident/immigrant, ethnic majority/minority, types of services they are looking for, etc.)
- 3. Based on your professional experience, what do you think are the causes and main risk factors of under-five mortality in your county? Why?**

Probes: What are the biggest barriers to improving child survival? If they mention environmental threats to children, Ask how should the health system address these? (A study from 2013 listed preterm birth complications, pneumonia, and intrapartum-related complications as the lead causes of U5M in China.)

- 4. Research has shown there are regional disparities or gaps in the under-five mortality rate between province sin China, in your view, what are the reasons for the regional disparities?**

Probes: If they mention economics: Do you think faster socioeconomic development

in Yunnan/Hubei could/did further reduce disparities and narrow/close the provincial under-five mortality gap? Why or why not?

II. Lessons from the MDG Era (Past Decade)

This portion will require you to recall events from your experience in the past decade in regards to the reduction of under-five mortality

- 1. Based on your interactions with patients, what has been the main hindrances to seeking MCH services?**
- 2. Based on your experiences and the services you provide, what are some of the best utilized practices related to improving child survival that were formed in the past decade (the MDG era)? What were some of the worst practices for improving child survival? Feel free to reference a specific anecdote or intervention program.**

Probes: One of the current major health system reforms is integrating health providers, therefore is integration of FP and MCH (best or worst)? If there are any at their institution, maternal education programs (free or w/cost)? (Providing care to mother's during pregnancy and childbirth, and after childbirth have been shown to be linked to child survival.)

- 3. The set of health reforms that started in 2009 included strengthening the health service system at the grass-roots level. In regards to child survival, and based on your work experience what changes did you perceive in MCH service provision and how did it impact your practice?**

Probes: Benefits and challenges of the cross-sectoral approach in reducing U5M? What policies worked or didn't? Do you feel that vertical (standalone) or horizontal (integrated) programs/interventions contributed to the U5M reduction in the past decade (MDG era)? Why? Please provide an example.

III. The SDG Era - Policy Implications (Future)

- 1. China recently adopted a two child-policy. As it relates to child survival, how do you foresee this new policy impacting your practice and your role as an MCH provider whose responsibility is to promote the well-being of mothers and children?**

Probes: Any challenges to improving service provision for overall quality improvement? How should the health system address these?

- 2. What role do you think you play in this new SDG era in order to improve child survival?**
- 3. Moving forward, based on your experience what factors needs to be given priority in the SDG era? Why?**

Probes: Strengthening of and even distribution of human resources for health or improvement of service quality in child health services? Telemedicine?

Appendix D

Key Informant Interview Guide for MCH Directors/ Administrators

Introduction/Purpose of KII

My name is Chisom Nwaneri and I am currently a Master's student of Dr. Shenglan Tang, the Executive Director for the Global Health program at Duke Kunshan University in the Jiangsu, Province.

I am here today to discuss under-five mortality in regards to maternal and child health services, and how the progress made with the United Nations' previous Millennium Development Goals (MDGs) can continue in regards to the health-related Sustainable Development Goals (SDGs). For this study I will focus on MDG 4, which was to reduce under-five mortality worldwide by two-thirds between 1990 and 2015. China achieved this goal at the national level nine years ahead of the 2015 deadline. In 2015 China was one of the countries that adopted the new Sustainable Development Goals set to be achieved by 2030. The new SDGs include ending preventable deaths of children under five years of age by 2030. We would like to hear your views about the current situation, the policies, achievements and challenges in regards to further reducing under-five mortality and the regional disparities that exist in the under-five mortality rate in China. For the purpose of this interview, the phrase "improving child survival" is synonymous with "reducing under-five mortality".

For the purposes of confidentiality, we will not record your self-introduction. I will only write down your position title, name of the MCH institution you work for, and your years of work experience in MCH, instead of name or other personal information. I will now start the audio-recording which was previously described during the consent process.

Information to be recorded:

- Job Position Title
- Years working in Maternal and Child Health

I. The Decline in U5MR (Present)

1. Can you briefly describe your educational background and your work experience in maternal and child health?
2. Based on your professional experience, how do you perceive the successes in the decline in U5M in your county? What do you think are the causes and main risk factors of under-five mortality in your county? Why?

Probes: What are the biggest barriers to improving child survival and health? PROB: socio-economic related health inequity? If they mention environmental factors, how should the health system address these? A study from 2013 listed preterm birth complications, pneumonia, and intrapartum-related complications as the lead causes of U5M in China.

3. Research has shown there are regional disparities or gaps in the under-five

mortality rate between province sin China, in your view, what are the reasons for the regional disparities?

Probes: If they mention economics: Do you think faster socioeconomic development in *Yunnan/Hubei* could/did further reduce disparities and narrow/close the provincial under-five mortality gap? Why or why not?

4. What does the process of reporting child deaths look like at this level? What is your opinion on the use of U5M data to in policy decision making to promote child survival and the reduction of under-five mortality?

Probes: Benefits and challenges to this registration process? Who has access to this data? Do decision makers have access?

II. Lessons From the MDG Era (Past Decade)

This portion will require you to recall events from your experience in the past decade in regards to the reduction of under-five mortality

1. The comprehensive health reform that started in 2009 included providing equal access to a basic medical insurance system, strengthening the health service system at grass-roots level, promoting equality in basic public health service delivery, establishing a national drug system, and implementing pilot reform in public hospitals. In regards to child survival, from your perspective, what were the positive and negative impacts of this health reform on child mortality?

Probes: Which of the five aspects of the reform do you think had the largest impact on child survival? Benefits and challenges of the cross-sectoral approach in reducing U5M? What policies worked or didn't? Do you feel that vertical (standalone) or horizontal (integrated) programs/interventions contributed to the U5M reduction in the past decade (MDG era)? Why? Please provide an example

2. In terms of health financing, do you feel adequate financial investments were made in MCH services?

Probes: Research studies have shown that China's public hospitals are underfunded and doctors are underpaid.

3. In terms of health services organization and provision, what has worked in improving access to MCH services? What has not worked?

Probes: In your view, what impact has the lack of an effective primary care system in China had on child survival?

4. In terms of the health workforce, how has the professional training and distribution of MCH health professional impacted child survival?

III. The SDG Era - Policy Implications (Future)

1. China recently adopted a two child-policy. Has this province adopted the new policy? One study suggests that countries should reduce fertility rates in order to have an impact on under-five mortality. How do you foresee this new policy impacting your institution and potential challenges on the reduction of under-five mortality in your county during the SDG era?

Probes: In addition to an increase in fertility rate from this new policy, the shortage of pediatricians in China creates a double burden. Quality of care? How should the health system address this double burden situation?

2. Moving forward with improving child survival in the SDG era, based on your experience what aspects needs to be given priority? *Especially in Yunnan where all 55 minority populations are present and U5MR is higher in these populations.*

Probes: The strengthening and even distribution of human resources for health or improvement of service quality in child health services? What role do you propose MCH institutions play in this new SDG era in order to improve child survival? Health Policy Reform? Community interventions?

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