PEDIATRIC INFECTIOUS DISEASE IN RESOURCE-LIMITED SETTINGS: DESCRIBING POST-DISCHARGE MORTALITY IN UGANDA

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Abstract

Background and Objectives

Pediatric post-discharge mortality in low-resources settings is a topic only starting to be understood. However, it has been largely demonstrated that children are dying after hospitalization, and in rates yet to be fully realized. Using Critical Social Theory as a framework, objectives included: to determine the current evidence addressing pediatric post-discharge mortality in resource-poor settings; determine potential predictor variables for infant post-discharge mortality at the time of initial hospital admission; and to establish the state of knowledge of social justice in global health within the nursing profession and provide clarity and understanding to the concept.

Methods

A manuscript-style approach was used, wherein each manuscript addresses an individual objective. This is achieved using a systematic literature review, modified two-stage Delphi process, and concept analysis.

Results

Rates of post-discharge mortality continue to be comparable to or exceed in-hospital mortality, with most post-discharge deaths occurring at home. Risk factors consistently highly associated with post-discharge mortality underlay the vulnerability associated with factors regardless of underlying infectious etiology. Predictor variables for post-discharge mortality among infants brought objectivity and insight to aspects of predictive value, reliability, availability, and applicability in low-resource settings. The identified variables are a valuable starting point for the construction of a predictive model to identify at-risk infants. A greater understanding of social justice, in particular within a global health context for the nursing profession, is developed for nursing to move to a more global practice as agents of social change.

Significance

Children continue to die unnecessarily and in staggering, under-recognized numbers, particularly in countries where strained and resource-limited health systems attempt to assist millions of socioeconomically disadvantaged children. Addressing these issues, identifying the most vulnerable children, and developing effective interventions is essential for achieving the

Sustainable Development Goals outlined by the United Nations. Every day nurses as key members of health care teams around the world play a critical role in the health and wellbeing of patients, families, communities, and nations. Nursing has a vital role to play in not only addressing childhood post-discharge mortality, but in global health in its entirety. It must be a concerted effort on all parts, from health care teams to policy makers, community leaders, researchers, and funders.

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To God be the glory.

Preface

Chapter 1

This chapter was written by Brooklyn Nemetchek and is not currently in submission for publishing; however, sections may be published at a later date.

Chapter 2

A version of this chapter has been accepted for publication in BMJ Open (Nemetchek, English, et al., 2018). This study was conceived, designed, implemented and written by Brooklyn Nemetchek in coordination with Matthew O. Wiens. Lacey English assisted with the independent review of retrieved articles and the extraction of the data from eligible articles. Co-authors reviewed and edited the manuscript.

Chapter 3

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Chapter 4

A version of this chapter has been submitted for publication. The paper was designed and written by Brooklyn Nemetchek. Matthew O. Wiens and Susan Fowler-Kerry reviewed and edited the manuscript.

Chapter 5

This chapter was written by Brooklyn Nemetchek and will not be published.

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CHAPTER 1: Problem Overview and Research Goals

The eight United Nations (UN) Millennium Development Goals (MDGs), signed in September 2000 by all UN Member States, committed world leaders to unprecedented efforts towards meeting the needs of the world's most vulnerable (United Nations, 2015a). The specific targets and indicators were to be met by the year 2015 (United Nations, 2015a). The MDGs produced a historic level of global mobilization, as they championed political accountability and global awareness towards the achievement of the eight goals (Sachs, 2012). The fourth MDG emphasizing the reduction of child mortality was measured using a target of a two-thirds reduction between 1990 and 2015 in under-five mortality rates (United Nations, 2015a). It is estimated that under-five mortality dropped from 90 to 43 deaths per 1,000 live births during the MDGs, making it one of the most significant achievements in human history (United Nations, 2015a). Despite the improvement made, most regions—including most countries in Sub-Saharan African—did not achieve the fourth MDG, nor were they projected to achieve it within the following ten years based on child mortality trends together with anticipated rates of population growth (United Nations, 2015a). Although incredible progress was indeed made during the era of the MDGs, the heavy burden of death remains, particularly in Southern Asia and Sub-Saharan Africa (United Nations, 2015a). In 2015, Sub-Saharan Africa alone carried the burden of 3 million under-five deaths—about half of the world's total under-five mortality (United Nations, 2015a). Furthermore, the under-five population in Sub-Saharan Africa is expected to rise substantially in the coming decades, indicating that unless progress is made in reducing the under-five mortality rate, deaths in this group, the number of children dying every year will undoubtedly increase (United Nations, 2015a). Although the MDGs proved that substantial world change can be realized, further progress requires political will and long-term, collective effort tackling root causes of inequality and social determinants of sustainable development (United Nations, 2015a). The MDGs have now been superseded by the 2015 Sustainable Development Goals (SDGs), a set of 17 goals which build on the achievements realized by the MDGs, but are far broader, deeper, and ambitious in scope, emphasizing the urgency of sustainable development for the entire world (United Nations, 2015b).

The third of seventeen Sustainable Development Goals is to "ensure healthy lives and promote well-being for all at all ages" by the year 2030 (United Nations, 2015b). A key aspect of this

goal is decreasing the rate of under-five mortality. Although pediatric mortality rates worldwide have gone down to about 7 million from 9.5 million per year, children in low-and-middle-income countries (LMICs) are now more than 18 times more likely to die than those in high-income countries, up from 14 times more likely in 1990 (Kissoon & Carapetis, 2015). It has been well-documented that these deaths result largely from infectious diseases (including malaria, pneumonia, diarrhea, etc.), of which the physiological result is sepsis. Sepsis itself has implications clinically, socially, economically, and politically (Kissoon & Carapetis, 2015).

1.1 Sepsis

The word "sepsis", derived from Greek, was initially used by Hippocrates to refer to "flesh rots," and then in the medical context by Homer in his poems (Funk, Parrillo, & Kumar, 2009). Sepsis has been defined and re-defined over the years. In 2016, the Society of Critical Care Medicine and the European Society of Intensive Care Medicine led a task force to update the outdated 2001 definition of sepsis (Singer et al., 2016). Coined as "Sepsis-3," the task force recommended that sepsis be defined as "life-threatening organ dysfunction caused by a dysregulated host response to infection" (Singer et al., 2016, p. 804). It further defines clinical organ dysfunction as an increase of 2 or more points in the Sequential [Sepsis-related] Organ Failure Assessment (SOFA), and septic shock as a subset of sepsis wherein underlying circulatory, cellular, and metabolic abnormalities are profound enough to markedly increase risk of hospital mortality to greater than 40% (Singer et al., 2016). A new clinical score, quickSOFA (qSOFA) was proposed along with the new sepsis definition, which includes utilizing at least two of the following identifiers to identify adults with suspected infection as more likely to have poor outcomes of sepsis: respiratory rate of 22/minute or greater, altered mentation, or systolic blood pressure of 100mgHg or less (Singer et al., 2016). The updated definitions, along with specific clinical criteria, offer more consistency and will hopefully assist in early identification and management for those at risk for sepsis (Singer et al., 2016). However, it is pertinent to mention that the definition and clinical scores were developed for adults; a pediatric definition and clinical scoring guidelines need to be validated for pediatrics as a unique population with diverse pathophysiological and clinical considerations (Schlapbach & Kissoon, 2018).

Although true numbers are difficult to estimate, sepsis claims an estimated 8 million lives every year, 420,000 of which are newborns (Dugani, Laxminarayan, & Kissoon, 2017). One study

extrapolated from data gathered from hospitals in high-income countries, and suggested that sepsis contributes to a global estimate of 30 million cases per year, resulting in 6 million deaths (Kissoon et al., 2017). However, this number is probably a significant underestimate of sepsis' true burden, as quantification in low and middle-income countries (LMICs) is sporadic and incomplete (Dugani et al., 2017). Furthermore, LMICs, where sepsis is concentrated with minimal emphasis or programs to address it, hold more than 90% of the burden of childhood sepsis (Kissoon et al., 2017). Sepsis accounts for a high number of total under-5 deaths, with most occurring in resource-limited settings of Sub-Saharan Africa and Asia (Kissoon & Carapetis, 2015). However, sepsis as a cause of death is often not reflected in data, which frequently attributes cause of death to specific illnesses such as malaria, pneumonia, and diarrheal diseases, all of which have sepsis as a final common pathway (Kissoon & Carapetis, 2015).

By acknowledging sepsis as the final result of severe infectious illness, practical interventions that are implementable by those with limited training in areas with low resources are made possible (Kissoon & Carapetis, 2015). In many LMICs, a shortage of skilled health workers often results in care being delivered by teams with minimal training (Kissoon & Carapetis, 2015). Highlighting simple emergency interventions common to sepsis and not specific to infectious agent or body system will manage the complex syndrome that is sepsis rather than focusing on multiple individual disease entities (Kissoon & Carapetis, 2015). Identification of individual, specific disease processes is important for areas such as research, prevention, vaccine development, and epidemiology (Kissoon & Carapetis, 2015). However, identification of sepsis regardless of source is required because the most life-critical interventions are generic and must be initiated before definitive diagnoses are identified (Kissoon & Carapetis, 2015). Sepsis is time-sensitive. Compartmentalizing care (e.g. malaria, pneumonia) in severe infection may not only delay proper treatment, but may also be redundant because malnutrition, pneumonia, and diarrhea often coexist in pediatric patients in LMICs and may be hard to differentiate with complete certainty (Kissoon & Carapetis, 2015). It is well documented that severe infection leads to sepsis, severe sepsis, and septic shock. Furthermore, initial treatment for most severe infection is limited, and usually include broad-spectrum antibiotics, fluid administration, blood products, oxygen administration, and frequent monitoring by medical personnel (Kissoon & Carapetis,

2015). By acknowledging sepsis as the common pathway and creating locally relevant, implementable guidelines for treatment, children with severe infections can be treated and survive.

The UN SDGs have a target to reduce neonatal mortality to less than 12 deaths per thousand live births and under-five mortality to less than 25 deaths per thousand live births by the year 2030 (United Nations, 2015b). Social determinants of sepsis are included within the SDGs, including targets to affect change in education, environment, and climate change (Dugani et al., 2017). Although gains were made during the MDGs and further gains expected in the era of the SDGs, sepsis threatens to stall those gains towards childhood survival (Dugani et al., 2017). Worldwide, sepsis remains the leading killer of children (Kissoon & Carapetis, 2015). Solutions to the burden of sepsis will not be found in silos, but through global concerted efforts and comprehensive strategies (Dugani et al., 2017).

Any clinical guidelines developed to address infectious disease and sepsis need to take into consideration the local context and available resources (Kissoon & Carapetis, 2015). Many guidelines proposed by the Surviving Sepsis Campaign are unable to be implemented in African countries, with one study finding that only 1.5% of 263 African sites had the resources to entirely implement the guidelines (Baelani et al., 2011). One program evaluated infrastructure and availability of medicines across six African countries; where available, results shows that 49-77% had appropriate equipment including thermometers, etc., and that only 13-57% had infrastructure such as electricity and water (Service Delivery Indicators (SDI), 2017). Another study conducted in over 41 countries found that of the 101 hospital facilities, 20% lacked triage and 70% were not applying sepsis protocols (Kang, Chandler, Espinosa, & Kissoon, 2014). It is clear that targets and treatment guidelines tailored to the resources and environment of individual LMICs, coupled with increased prevention, awareness, and early recognition of sepsis, are of utmost importance if reductions in child death due to infectious disease are to be attained (Reinhart et al., 2017).

Health care in many resource limited settings, including care for children with infectious illness, is plagued by issues related to recognition and treatment of disease, and social and economic barriers to care (Kissoon & Carapetis, 2015). A lack of education, money, faith in supernatural causes of illness and disease, traditional remedies, long distances, difficulty of transport, long

wait times, and basic health procedures not being followed are only some among many health barriers faced by much of the world (Kissoon & Carapetis, 2015) Furthermore, a lack of women empowerment often has a detrimental effect on their health seeking behavior for children (Kissoon & Carapetis, 2015). The overall low-emphasis on prevention and inadequate management of staff shortages (including nursing) are also coupled with health care inequity and poor regulation in health sectors, with many medical personnel trained in developing countries migrating to practice in the developed world (Kissoon & Carapetis, 2015).

The prevention, awareness, and early recognition of sepsis are instrumental aspects of addressing the huge global burden that sepsis poses the world, especially for children living in low-resource settings. Many infectious causes of sepsis, such as meningitis, pneumonia, diarrhea, measles, and dengue fever, have the potential to be prevented through global access to cost-effective vaccines (Kissoon et al., 2017). Vaccines currently prevent an estimated 2-3 million deaths per year (World Health Organization, 2017a). However, in 2016, an estimated 19.5 million children had not yet been vaccinated with diphtheria-tetanus-pertussis (DTP3), a life-saving vaccination requiring three doses (World Health Organization, 2017b). Furthermore, improved vaccination rates may also have a positive impact on the global concern of antimicrobial resistance due to inappropriate use of antibiotics (Kissoon et al., 2017). Other key preventative measures such as hand hygiene and preventing nosocomial infections require strengthening globally in order to impact rates of death due to infectious causes. Sepsis education and public awareness about sepsis are needed in order to improve outcomes, as treatment involves early administration of antibiotics in order to prevent deaths (Reinhart et al., 2017). The early management of sepsis does not require high-technology laboratory information, but rather the administration of broad-spectrum antibiotics and supportive therapies, which can be accomplished by simple and available technology (Kissoon et al., 2017). The prevention, identification, and management of sepsis further requires developing resilient and robust healthcare systems in many countries where fragmentation and limited pathways to respond are prevalent (Kissoon et al., 2017).

1.1.1 World Health Assembly (WHA) Resolution on Sepsis

The United Nations World Health Assembly, as the decision-making body of the World Health Organization (WHO), passed a resolution on May 26, 2017 which urges member states to not only recognize sepsis as a global challenge, but to take measures to improve prevention,

diagnosis, and management (Kissoon et al., 2017). The resolution emphasizes sepsis as a global threat and was adopted by all 194 United Nations member states (Dugani et al., 2017). The specific recommendations proposed by the Resolution directed towards member states and the director general (

Table **1**) encompass important steps towards both the global recognition of sepsis and towards reducing the burden of a neglected yet major cause of morbidity and mortality worldwide (Kissoon et al., 2017). From developing robust and resilient healthcare systems, to preventing infection, supporting early recognition and treatment of sepsis, increasing awareness and advocacy, the resolution is a landmark step towards achieving the SDGs and lasting change, especially for the world's most vulnerable (Kissoon et al., 2017). The WHA Resolution on Sepsis could save millions of lives; however, coordinated action on the recommendations is required by the world—by international and local governments, policy makers, researchers, health care administrations, medical and pharmaceutical companies, health care workers, individuals, and communities working together towards change (Dugani et al., 2017; Reinhart et al., 2017). The resolution is one part of a concerted effort towards achieving the targets outlined by the United Nations SDGs and driving lasting change (Kissoon et al., 2017).

1.2 Post-Discharge Mortality

A systematic review of pediatric post-discharge mortality in resource-poor settings conducted by Wiens et al. (2013) found that rates of pediatric post-discharge death were often as high as in-hospital mortality rates. Risk factors identified for mortality post-discharge included young age, malnutrition, HIV, pneumonia, and recent prior admissions (Wiens et al., 2013). The data further suggested that morbidity and mortality could be decreased by improved discharge planning and post-discharge care (Wiens et al., 2013). Although most studies did not detail place of deaths, in those studies which did it was found that two-thirds of deaths following discharge occurred outside of the formal health system, suggesting that the vulnerable often do not re-enter the health system during the critical post-discharge period (Wiens et al., 2013). These largely preventable deaths following hospital discharge are critical and have not received recognition, either locally, nationally, or on the global platform (Wiens et al., 2013). It is from this setting that questions arise around the ways that in-hospital care can support pediatric patients to fully recover and then be discharged safely so that re-admission and death post-discharge are decreased.

Literature exploring the topic of post-discharge mortality in low-resource settings is lacking, particularly in the qualitative paradigm. However, several studies reveal a number of themes and factors contributing to aspects of the topic in developing countries. A mixed-method study

conducted in Uganda by English et al. (2016) evaluated the context and barriers to seeking care for children who died out-of-hospital after an infectious illness. Within the context of poor maternal education and many environmental conditions, factors contributing to death were found to be complex and included financial constraints, transportation, delayed health care seeking, and an unawareness of post-discharge risks (English et al., 2016). Although most guardians pursued multiple avenues of care including traditional healers and spiritual support, if the child was recently discharged there was hesitancy to seek immediate care due to perceptions of being cured even if symptoms continued (English et al., 2016). The child's death and available medical resources were accepted as unchangeable by many caregivers (English et al., 2016).

A second Ugandan study characterized sociocultural and structural barriers to prompt medical care in hospitalized children with severe malaria (Sundararajan et al., 2015). Sociocultural factors encompassed the distinction between "traditional" versus "hospital" illnesses, which the caregiver considered mutually exclusive, as well as the generational conflict wherein following one's elders counsel is expected (Sundararajan et al., 2015). Structural factors included inadequate health-care resources, inadequate finances limiting advanced care, and the impact of finances on the household economy, all which continue the cycle of illness, debt, and poverty (Sundararajan et al., 2015).

A Brazilian study sought to understand the meaning given to the post-discharge experience by the family of a child discharged from an acute illness (Pinto, Mandetta, & Ribeiro, 2015). Findings suggest that families remain vulnerable after discharge and yet the family may be mobilized to prevent readmission in order to avoid further suffering (Pinto et al., 2015). The theoretical model developed by the study suggests that health professionals must help the family prepare for discharge and continue supporting the family past the child's recovery or discharge from hospital (Pinto et al., 2015). Furthermore, this study identifies the influence of family and elders upon the post-discharge decisions made by caregivers (Pinto et al., 2015).

Discharge against medical advice (AMA) has the potential to be a factor contributing to mortality post-discharge in pediatric populations. A lack of family-centered care, disruption of parenting, distrust of the medical team, and the psychological strategy of shirking responsibility for care and treatment were the main themes discovered by an Iranian study exploring parents'

decisions to discharge their child AMA (Alireza, Hamid, & Jamalodin, 2016). The decision to discharge AMA and its subsequent adverse effects show the breakdown in communication and interaction between the health care team and patients (Alireza et al., 2016).

Many factors and themes can be seen through these studies as they contribute to post-discharge death in developing countries. The caregiver's perceived decision between "traditional" versus "western" medicine is paired with cultural and generational conflict in the choice (English et al., 2016; Pinto et al., 2015; Sundararajan et al., 2015). Furthermore, distrust of hospital medicine and its financial burden compound the decision, which can lead to either a delay in seeking health care, discharging the child against medical advice, or not seeking further care after discharge at all even when a child's condition worsens (Alireza et al., 2016; English et al., 2016; Sundararajan et al., 2015).

1.3 Studies from Uganda

The opportunity to experience first-hand living and working in Uganda as a Masters of Nursing student enabled a greater understanding and appreciation of culture, environment, and social determinants of health impacting the health sectors of the country. With an estimated population of over 42 million in 2017, Uganda's population is one of the youngest (median age 15.8 years, life expectancy 55.9 years) and most rapid-growing in the world (Central Intelligence Agency, 2018; United Nations, 2017). This population is most heavily concentrated in southern and central Uganda (Central Intelligence Agency, 2018). With 42.9 births per 1,000 population, each woman gives birth to an average of 5.71 children (Central Intelligence Agency, 2018). However, infant mortality rates continue to be much higher than those outlined in the SDGs, at 56.1 deaths per 1,000 live births in 2017 (Central Intelligence Agency, 2018).

Uganda has both private and public health sectors. However, for those unable to pay the high fees-for-service of private facilities, severe shortages in availability of health personnel, infrastructure, medicines, and equipment are often the reality faced by the many accessing care in public health centers. The country has a shortage of skilled health care workers, with doctors and nurses trained in Uganda emigrating to other nations due to the low wages paid by both private and public sectors; this has resulted in a physician density of 0.09 physicians per 1,000 people as of 2015 (Central Intelligence Agency, 2018). A lack of health care infrastructure can be demonstrated by the hospital bed density of 0.5 beds per 1,000 (2010 statistics) (Central

Intelligence Agency, 2018). Not only do Ugandans face threat of major infectious diseases such as bacterial diarrhea, pneumonia, hepatitis A and E, typhoid fever, malaria, dengue fever, schistosomiasis, and trypanosomiasis-gambiense (African sleeping sickness), but the country is further burdened by an adult HIV/AIDS prevalence rate of 6.5%, with an estimated 28,000 individuals dying each year as a direct result of HIV/AIDS (Central Intelligence Agency, 2018). Furthermore, Uganda's public health sector struggles to support not only native Ugandans, but also the hundreds of thousands of refugees from South Sudan, the Democratic Republic of the Congo, Burundi, Somalia, and Rwanda (Central Intelligence Agency, 2018). Understanding availability and access to needed health care is an important area of study in low-resource countries, including Uganda. In the face of the global movement towards achieving the SDGs, identifying and reaching the previously un-reached has gained increased priority. Reading histories, knowing statistics, identifying health issues and barriers; these are required in order to understand a country. However, it was through then experiencing Uganda's health care sectors firsthand that I was able to understand the statistics and history, gaining a fuller, more complete lens with which to frame the health of people in Uganda. All peoples of the world are important and deserving of an opportunity for health.

Post-discharge mortality for pediatric populations in low-resources settings, and specifically in Uganda, is a topic only starting to be understood. However, it has been largely demonstrated that children here are dying after hospitalization, and in rates yet to be fully realized. Having spent a total of nine months living in Uganda on two occasions, I was able to not only gain an understanding of Ugandan society and culture, but also the greater issues and powers related to health and mortality in children. It is upon these lived experiences—the many conversations, experiences, explanations gathered, and observations with local Ugandans—which my understanding of this important and yet often forgotten population have been framed.

1.4 Conceptual Framework: Critical Social Theory

Critical Social Theory (CST) has gained prominence in nursing as a theoretical and philosophical orientation to scientific inquiry (Browne, 2000). The framework addresses issues of power inequity, structural constraints, and oppression as the context of health and health care (Browne, 2000). CST saw its beginnings in the "Frankfurt School"—the Institute for Social Research at Goethe University in Frankfurt, Germany— and in the writings of critical theorists since (Scott,

1978). CST as a term is frequently used by second-generation critical theorist Jürgen Habermas, using it to differentiate between the Frankfurt School's 'Critical Theory', Bhaskar's 'critical realism', and Giddens 'social theory' (Pleasants, 1999). Although many strands of theory may be encompassed by or associated with the term CST, they share many overarching values and assumptions (Browne, 2000; Pleasants, 1999).

CST assumes a realist ontology, rejecting radical relativism in favour of objectively valid scientific and social knowledge (Pleasants, 1999). Positivism and empiricism are rejected and "condemned for providing theoretical legitimation for manipulative and exploitative social sciences and technologies" (Pleasants, 1999, p. 6). It is posited that social order always entails some extent of domination, oppressive structures, and unequal power, and that critiquing the pervasive social order is one way to prompt social transformation towards emancipation and empowerment (Browne, 2000). Although generally well-intentioned, mainstream research often maintains and perpetuates oppression (Browne, 2000). Therefore, CST should instead offer a critique for the goal of identifying and understanding patterns of complacency and status quo in societies or cultures, ultimately promoting change and justice (Browne, 2000). Emancipation is achieved through revealing hidden dominion and power inherent in the fundamental structure and ideologies of societies (Browne, 2000).

From the fundamental basis of CST, Brazilian educator and critical theorist Paulo Freire (1921-1997) drew upon Catholic liberation theology and Marxist ideas, his works eventually becoming foundational to the field of critical pedagogy (Gibson, 1999; Thomas, 2009). In Freire's book, Pedagogy of the Oppressed (1970), he promotes an idea of liberation through both reflection and action, resulting in transformation of the conditions that lead to and perpetuate oppression (Mooney & Nolan, 2006). Freire emphasized the importance of each person's culture and experiences, and affirmed the CST position that social phenomena cannot be understood apart from their context and history (Fulton, 1997). Freire's theory transcends discipline, having been used by development studies in regards to understanding and facilitating participatory-action based liberation and democracy in Sub-Saharan African settings (Thomas, 2009).

CST was virtually unused as a nursing science philosophical orientation until the 1980's, at which time nurses began to identify it as a way to broaden the focus of nursing science and decrease the theory-practice gap (Browne, 2000). Using CST as a framework for nursing

strengthens the link between knowledge and theory to direct social action towards improving health and healthcare (Browne, 2000). The philosophical framework holds particular appeal for nurses interested in issues of social justice (Browne, 2000). The nursing profession's social and moral mandates to not only the populations directly serviced but to the greater society are inherently emancipatory; CST has been argued to be able to enhance the emancipatory potential already ingrained in the profession (Browne, 2000). Nursing, using CST, has the potential to develop and improve strategies for health and healthcare and push nursing past the realm of individual care towards care for societies and peoples around the world. The perspective of CST informs each manuscript, providing a unifying element to each chapter.

1.5 Research Objectives

Using Critical Social Theory as a framework with which to link and understand concepts, the three research objectives of this thesis include:

1. To determine the current evidence base addressing pediatric PDM in resource-poor settings; determining risk factors, rates of mortality, timing, and location of deaths for children following discharge from hospitals. This will be addressed in chapter two by an updated systematic review of pediatric post-discharge mortality in resource limited settings.
2. Based upon previously identified risk factors, to determine potential predictor variables for post-discharge mortality, specifically for infants, at the time of initial admission to hospital. This will be addressed in chapter three through a modified two-stage Delphi process involving variables evaluated based on (1) predictive value, (2) measurement reliability, (3) availability, and (4) applicability in low-resource settings.
3. To establish the state of knowledge of social justice in global health as a concept within the nursing profession and provide clarity and understanding, from which nurses may proceed to be agents of social change on both national and international stages.

CHAPTER 2: Pediatric Post-Discharge Mortality in Developing Countries: A Systematic Review

2.1 Introduction

The third of seventeen United Nations Sustainable Development Goals emphasizes preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce under-5 mortality to at least as low as 25 deaths per 1,000 live births by the year 2030 (United Nations, 2015b). Although significant progress was made during the Millennium Development Goal era (1990-2015), preventable childhood deaths remain high in Southern Asia and Sub-Saharan Africa (Wiens, Kissoon, & Kabakyenga, 2018). These deaths result largely from infectious diseases (including malaria, pneumonia, diarrhea, etc.), that lead to sepsis (Reinhart et al., 2017). Children are particularly vulnerable in the months following hospital discharge, with a growing body of research demonstrating that post-discharge deaths occur in similar numbers as during hospital admission. Despite the staggering burden of post-discharge mortality, this issue has been largely neglected when examining pediatric mortality from infectious disease. The 2017 United Nations World Health Assembly (WHA) resolution calling for improvement in prevention, diagnosis, and management of sepsis is timely as it emphasizes the need for improved follow-up care, particularly for low and middle income countries, within their recommended actions for reducing the burden of sepsis globally (Kissoon et al., 2017). Member states are urged to emphasize sepsis' impact on public health, of which post-discharge mortality is a crucial aspect (Wiens et al., 2018). Thus, as the international community works towards achieving the WHA resolution and the third SDG, addressing the burden of pediatric post-discharge mortality is of vital importance.

A systematic literature review conducted in 2012 examined the burden of pediatric post-discharge mortality in resource poor countries (Wiens et al., 2013). This systematic review found that the rate of pediatric post-discharge death is often as high as in-hospital mortality rates, with two-thirds of these deaths occurring outside the health system, usually at home. Common risk factors for post-discharge mortality included young age, malnutrition, HIV, pneumonia, and recent prior admissions.

Despite the high burden of post-discharge death, this issue continues to receive insufficient recognition at either national or international levels. The lack of research and data highlighting

the burden of post-discharge mortality relegates care following discharge as a low priority to policy makers. Additional studies published since the last systematic review contribute to the growing evidence base that can galvanize both researchers and policy makers to action.

The purpose of this systematic review, therefore, is to update the literature addressing the critical nature of pediatric post-discharge mortality in resource-poor settings, propelling research and interventions toward the goal of reduced child mortality.

2.2 Methods

2.2.1 Objective and Study Eligibility Criteria

The primary objective was to determine the risk factors and rates of mortality in children following discharge from hospitals in developing countries. **Table 2** outlines the study inclusion eligibility, determined through the PICOS (Population, Interventions, Comparisons, Outcomes, and Study Design) format.

2.2.2 Patient and Public Involvement

Patients and the public were not involved in the design or conduct of this study.

2.2.3 Search Strategy

Articles published and indexed between January 1, 2012 and July 18, 2017 were identified using the MEDLINE and EMBASE databases within the OVID platform. The detailed search strategy for each database is outlined in **Appendix 1**. Studies conducted prior to 2012 were identified from a prior publication, using a similar search strategy (Wiens et al., 2013). Articles were included if the study was conducted in a developing country (defined as countries currently (2016) classified by the United Nations Development Program (UNDP) as having a low Human Development Index plus those countries included previously (2011) as having a low Human Development Index), included children admitted to hospital for medical reasons, and included follow-up to capture vital status during the post-discharge period (Jahan, 2016; Klugman, 2011; Wiens et al., 2013). Furthermore, references of all included articles were reviewed to identify other potentially eligible studies not captured in the systematic search.

2.2.4 Study Selection and Data Extraction

Two investigators (BN, LE) independently screened articles during two rounds of review. The first round consisted of reviewing all abstracts for the presence of specific exclusion criteria. The

second round of review consisted of a detailed review of remaining articles in full text format. In both rounds, any discrepancies were resolved through discussion and consensus. A third investigator (MW) provided arbitration for any discrepancies not resolved through consensus.

For eligible studies, the characteristics extracted included author, title and year of publication, year of study, country, study design, facility, population (diarrhea, malaria, all admissions, etc.), time of enrollment (admission or discharge), number of subjects, age, sex, and study eligibility criteria. Outcomes extracted included total numbers of subject who died both in-hospital and following discharge, timing and location of post-discharge deaths, follow-up method and losses to follow-up, number of post-discharge re-hospitalizations and health seeking, timing of re-hospitalizations and health seeking, and risk factors for post-discharge mortality. When extracting data on risk factors, the results of multivariate analysis were preferentially extracted over univariate analyses.

2.2.5 Risk of Bias

A formal risk of bias assessment, such as the Newcastle Ottawa Quality Assessment Scale for Cohort Studies, was not conducted since the primary outcome of the rate of post-discharge mortality was not exposure related among included studies. Primary factors leading to potential bias include the percent follow-up as well as whether inclusion criteria were correctly applied to enrolled subjects, leading to a representative sample of the population. While the former was included in the outcome characteristics, the latter was not defined in any study. Thus, proportion of children successfully followed remains the primary indicator of risk of bias.

2.3 Data Analysis and Outcomes

Microsoft Excel (Redmond, WA) was used to compile extracted data. Due to varying populations, risk factors, definitions, and types of results (e.g. odds ratio, hazard ratio), a formal meta-analysis was not deemed possible. Therefore, the analysis was descriptive in nature. The primary outcome was the proportion of discharged subjects who died during the post-discharge period. Secondary outcomes included the proportion of total deaths (in-hospital and post-discharge) which occurred following discharge, as well as risk factors associated with post-discharge mortality. Given that several distinct populations were evaluated, results were reported according to the underlying study population. Studies were grouped according to five underlying populations: (1) all admissions including those for infectious diseases, (2) malnutrition, (3)

respiratory infection, (4) diarrheal diseases, and (5) malaria/anemia.

2.4 Results

2.4.1 Summary of Included Articles

A total of 1238 articles were identified through the systematic searches, with two additional articles identified independently. Of these, 1174 were excluded at the abstract stage and a further 55 were excluded during the full text screening stage, resulting in 11 eligible studies (**Figure 1, Appendix 2**). These 11 studies were added to the 13 studies identified prior to 2012 through a similar systematic search by Wiens et al. (2013) resulting in a total of 24 included studies (**Table 3**). Studies were grouped according to underlying population. Three studies examined either all admissions or all infectious admissions, five examined malnutrition, seven respiratory infection, three diarrheal diseases, and six included children with malaria and or anemia. Seven randomized controlled trials, 12 prospective cohorts, two retrospective cohorts, and three case-control studies were included. Two studies examined those admitted to a health center, whereas the remaining 22 were conducted at various types and levels of hospitals. All studies were performed in a single country, and Bangladesh was the only non-African country in which included studies were conducted.

2.4.2 All Admissions, Including Unspecified Infectious Admissions

The three studies within this population were conducted between 1991 and 2013 in Guinea-Bissau, Kenya, and Uganda, and enrolled between 1,307 and 10,277 subjects (**Table 3**) (Moisi et al., 2011; Veirum, Sodeman, Biai, Hedegard, & Aaby, 2007; Wiens et al., 2015a). Follow-up periods ranged from 6 months to 1 year, with post-discharge mortality ranging from 4.9% to 8% (**Table 4**). Two studies reported post-discharge re-admission, measured rates between 16.5% and 17.7% (Moisi et al., 2011; Wiens et al., 2015a). Inpatient mortality was recorded by two studies, finding rates of 4.9% and 15% (Veirum et al., 2007; Wiens et al., 2015a). These same studies recorded that most post-discharge deaths (67% and 77%) occurred outside of the hospital setting. The majority of post-discharge deaths occurred relatively early in the follow-up period, with 63% occurring within 13 (of 52) weeks in one study and 50% within 4 (of 24) weeks in the other study (Veirum et al., 2007; Wiens et al., 2015a). Several variables were included in risk factor analyses for post-discharge mortality (**Table 5**). Increasing age was shown to be a protective factor in all three studies. Parasitemia was found to be associated with lower PDM

compared to other diagnoses in two studies, with the third study showing lower PDM compared to diarrhea, anemia and other less common diagnoses. Bacteraemia, severe or very severe pneumonia, severe malnutrition, meningitis, and HIV were all associated with a higher probability of post-discharge death (Moisi et al., 2011; Wiens et al., 2015a). The study by Veirum et al. (2007) evaluated discharge against medical advice (AMA), and reported that those who left AMA were eight times more likely to die after discharge. Anthropometric factors (including MUAC, weight-for-age, weight-for-height, and height-for-age z-scores), hypoxia, respiratory rate, jaundice, hepatomegaly, and Blantyre coma scale rating were all associated with a statistically significant increase in the probability of PDM (Moisi et al., 2011; Wiens et al., 2015a). Those who had been hospitalized prior to the index admission were also at increased risk for death, with each additional hospitalization compounding the risk (Moisi et al., 2011; Wiens et al., 2015a).

2.4.3 Malnutrition

Five studies focusing on a malnourished population were identified. These studies were conducted in the Democratic Republic of the Congo, Malawi, Bangladesh, Kenya, and Uganda between 1970 and 2015, enrolling between 171 and 1778 children (**Table 3**). The period of follow-up varied widely in this sub-population, ranging from 8 weeks to 5 years (**Table 4**). Post-discharge mortality rates were observed to be between 1.8% and 24%. Where hospital mortality rates were measured (n=2), mortality following discharge was comparable to that observed during hospital admission, with one study reporting an inpatient mortality rate of 23.2% (24% after discharge), and a second study of 8.6% (8.7% after discharge) (Chisti et al., 2014; Kerac et al., 2014). Three of five studies specified the timing of deaths during the follow-up period with all finding that the majority of deaths following discharge occurred early during the follow-up period (relative to total follow-up); in one study, 59% of those who died after discharge did so within 52 weeks (of 5 years), another found that 44% died within 13 (of 52) weeks, and the third study observed 88% dying within 9 (of 26) weeks of discharge (Chisti et al., 2014; Hennart, Beghin, & Bossuyt, 1987; Kerac, 2014). A study conducted in Bangladesh reporting the location of post-discharge death found that 80% of deaths occurred at home, while another conducted in Kenya found 53% occurring in the community (Berkley et al., 2016; Chisti et al., 2014). Anthropometric parameters including MUAC, weight-for-age and weight-for-height z-scores

were among the highly significant predictors for death post-discharge (**Table 6**) (Chisti et al., 2014; Kerac et al., 2014). Age less than 12 months was associated with mortality in one study, but was found not to be significant in another, although wide confidence intervals could not rule out an important effect (Chisti et al., 2014; Kerac et al., 2014). Highly significant associations variables included positive HIV status (HR 4.03; 95%CI 3.08, 5.25), unknown HIV status (HR 16.90; 95%CI: 12.10, 23.70) and discharge AMA (HR 4.68; 95% CI: 2.01, 10.85).

2.4.4 Respiratory Infection

Seven studies examining respiratory infections were identified. These included children with a variety of inclusion criteria, including pneumonia, acute lower respiratory tract infection (ALRI), and tuberculosis. Studies were conducted between 1992 and 2014 in the Gambia, Tanzania, Bangladesh, Malawi, and Kenya (**Table 3**). Mortality rates post-discharge ranged widely, from 1.3%-35% across the studies. These rates, however, remained consistently comparable to inpatient mortality when both were measured (**Table 4**). As with other populations, mortality rates generally occurred early during follow-up. A large prospective cohort study by Ngari et al. (2017) including children aged 1-59 months with severe pneumonia found that 74% of post-discharge deaths occurred by 26 (of 52) weeks with 63% occurring outside of hospital. Chhibber et al. (2015) conducted a study of 3952 children admitted primarily with pneumonia in rural Gambia and sought to identify specific comorbidities and physiologic factors predictive of mortality after discharge. This study found that physiologic factors, including neck stiffness, oxygen saturation, temperature, and hemoglobin concentration were associated with post-discharge mortality. Malnutrition related variables (clinical malnutrition and low MUAC) were the strongest predictors of post-discharge mortality, producing hazard ratios ranging from 18.4 to 43.7 (

Table 7). Although individual studies differed in regards to whether risk factors were measured continuously, categorically, or dichotomously, it is clear that the directionality of certain risk factors such as low hemoglobin and low MUAC continue to be associated with higher PDM in pediatrics admitted for respiratory illness (Chhibber et al., 2015; Ngari et al., 2017; Villamor, Misegades, Fataki, Mbise, & Fawzi, 2005). When examining the timing of mortality, most cases occurred relatively early during follow-up. One study found that 80% had occurred by 12 months (mean duration of follow-up 24.7 months), another study had 55% by six (of 26) weeks, and yet another reported 74% by 26 (of 52) weeks (Chhibber et al., 2015; Ngari et al., 2017; Villamor et al., 2005). Low MUAC, stunting, HIV positive status, jaundice, low hemoglobin, under 24 months of age, and availability of water were significant predictors of post-discharge mortality among children with respiratory illness (Ngari et al., 2017; Villamor et al., 2005).

2.4.5 Diarrheal Diseases

Three studies of pediatric patients with diarrhea conducted between 1979 and 1992 were identified and included, all three of which were conducted in Bangladesh (**Table 3**). Included studies enrolled children aged 1-72 months and found post-discharge death rates of between 2 and 8%, all being generally comparable to in-hospital rates (**Table 4**). Deaths occurred within the first few weeks after discharge, with one study reporting 52% by 4 (of 52) weeks (Roy, Chowdhury, & Rahaman, 1983), and a second reporting 94% of deaths occurring by 6 (of 12) weeks post-discharge (Islam, Rahman, Mahalanabis, & Rahman, 1996). Significant risk factors for death after discharge identified in this set of studies included young age (<6 months), not having been breastfed, malnutrition (HAZ and WAZ scores), low levels of maternal education, and immunization status of the child (**Table 8**) (Islam et al., 1996).

2.4.6 Anemia and or Malaria

Six studies were conducted between 1991 and 2014 in Kenya, Guinea-Bissau, Malawi, and Uganda in children with anemia and/or malaria (**Table 3**). Studies were heterogeneous in their specified populations, including children with various illness severity, with mortality post-discharge ranging from 0.9% to 18.8%, and with follow-up periods ranging from 1-18 months (**Table 4**). In the only study looking specifically at acute malaria, post-discharge mortality (1.8% intervention; 0.9%% control) was lower than inpatient mortality (4.6% intervention; 9.4% control) over a follow-up period of 28 days (Biai et al., 2007). Another study that followed

children with cerebral malaria or severe malarial anemia for six months following discharge reported that although children with cerebral malaria experienced higher in-patient mortality (13% compared to 0.4%), those with severe malarial anemia had a higher rate of death after discharge (2.2% compared to 0.6%) (Opoka et al., 2016). A large study (n=1,414) by Phiri et al. (2012) examining severe malarial anemia found high rates of post-discharge readmission (approximately 22%), with rates of death at approximately 2.4%. Children with anemia experienced higher rates of inpatient (13% anemia; 9% no anemia) and post-discharge mortality (18.8% anemia; 10.3% no anemia) (Zucker et al., 1996). In both cohorts, death after discharge was greater than death in-hospital. Rates of re-admission to hospital within 18 months were quantified in one study (18.4% severe anemia; 9% no anemia) and post-discharge mortality rates (11.6% anemia; 2.7% no anemia) exceed those of inpatient mortality rates (6.4% anemia; 0% no anemia) (Phiri et al., 2008). Although this study had approximately 18% loss to follow-up, 71% of anemic and 60% of non-anemic total post-discharge deaths had occurred by 26 (of 78) weeks (Phiri et al., 2008). An RCT conducted in Uganda studied the effect of transfusion volume (30ml/kg verses the standard 20ml/kg) in severely anemic children, which showed reduced inpatient mortality rates but no difference for deaths after discharge (**Table 9**) (Olupot-Olupot et al., 2014). Rates of death were consistently higher after discharge than in hospital in pediatric patients presenting with malaria and or anemia. Of risk factors identified throughout these studies, severe anemia was found to be highly significant for post-discharge death and re-admission to hospital (Opoka et al., 2016; Zucker et al., 1996). HIV status profoundly influenced mortality, with a hazard ratio (HR) of 10.49 (95% CI 4.05, 27.20) for death post-discharge in children who tested positive (Phiri et al., 2008).

2.5 Discussion

Twenty-four studies examining post-discharge mortality in pediatric populations in developing countries were included in this systematic review, together substantiating the significant and unaddressed challenge continuing to plague children around the world. Significant heterogeneity in study characteristics was noted, within inclusion criteria, study design, length of follow-up, interventions (if any), risk factors, and risk factor definitions. Studies were conducted primarily in African countries, and examined a variety of populations, including all admissions, infectious disease admissions, malnutrition, respiratory infections, diarrhea, malaria, and anemia. Studies

examining anemia and or malaria had the lowest PDM rates, while those of malnutrition and respiratory infections had the highest. Results from the studies identified through the updated search generally reflected the results from the earlier systematic review; rates of post-discharge mortality continued to be high and comparable to (sometimes exceeding) in-hospital mortality, with most post-discharge deaths occurring at home (Wiens et al., 2013). With so many deaths occurring after discharge, it is critical that effective interventions be developed and evaluated as a means to addressing this neglected cause of childhood deaths. Furthermore, no analysis of cause for death post-discharge was identified within any of the reviewed studies, highlighting this as an important area for further research.

When reported, over two-thirds of post-discharge deaths were noted to occur outside of the hospital, generally at home. In order to develop interventions to reduce the burden of PDM, an understanding of circumstances and barriers to care following discharge is of utmost importance. In a recent qualitative study, mothers of children who died post-discharge identified barriers to seeking care prior to their child's death; barriers included lack of access to health facilities and services, poor health-seeking behaviour, finances, transportation, and a lack of recognition of symptoms and perceptions of recovery in children recently discharged even in the midst of persisting illness (English et al., 2016). Additional factors that contribute to poor socioeconomic conditions may relate to deaths after discharge, as they further disadvantage children and families. Socioeconomically disadvantaged children continue to be served by health sectors that are poorly resourced and lack the resilience to be able to deal with large numbers of patients seen every day. Follow-up care after initial hospitalization is an important and yet largely ignored aspect of comprehensive health care in both high and low income countries (Wiens et al., 2018). With so few patients returning to the health care system after discharge, identifying and understanding the barriers and targeted interventions required to enhance outcomes must be initiated during the original hospitalization.

Risk factors consistently identified across all types of infectious admissions as highly associated with post-discharge mortality included HIV status, young age, pneumonia, malnutrition, anthropometric factors, hypoxia, anemia, leaving the hospital against medical advice, and previous hospitalizations. An important observation, therefore, is that regardless of the underlying infectious etiology, certain risk factors consistently identify vulnerability. These

observations suggest that vertical, disease-based, approaches to addressing post-discharge mortality are likely to be ineffective in comparison to simple, broadly applicable interventions. Specific illness (i.e. pneumonia, diarrhea, malaria) are often both difficult to differentiate clinically and often co-exist, especially in children in low-resource settings (Kissoon & Carapetis, 2015). Sepsis, therefore, as the final common pathway for the majority of infectious disease related deaths, may be a helpful framework within which to explore pediatric post-discharge mortality and to develop interventions. Instead of focusing on a specific body system or infectious agent, pragmatic interventions towards time-sensitive treatment can be focused toward sepsis as the overarching syndrome, increasing the potential for impactful results (Kissoon & Carapetis, 2015). The Integrated Management of Childhood Illness (IMCI) pocketbook by WHO uses a similar approach through their identification of danger signs and treatments as opposed to individual diseases. Addressing sepsis through clinical management is an important component in the reduction of preventable childhood death, requiring sustained efforts by the global community including health care providers, patients, pharmaceutical companies, and policy makers if large-scale change is to occur (Dugani et al., 2017).

While knowledge of risk factors alone has only moderate utility in the identification of vulnerable children, the development of robust prediction models can provide a more reliable means of risk evaluation. In resource-limited environments, the use of prediction modeling is especially appealing, especially in relation to interventions aimed at improving post-discharge outcomes. A recent proof-of-concept study found that a simple discharge intervention including education and routine post-discharge follow-up could substantially improve post-discharge health seeking and health outcomes (Wiens, Kumbakumba, et al., 2016). Such approaches, if focused primarily on the most vulnerable children, can ensure that limited resources are most effectively utilized and have the highest possible level of cost effectiveness.

This systematic review is subject to several important limitations. First, it is possible that some relevant articles may not have been identified through the systematic search. Although the search was comprehensive, including both Medline and EMBASE, no MeSH/Emtree terms currently exist for post-discharge mortality and even so, many studies measure post-discharge mortality as a secondary endpoint. A further limitation of this review is that the studies included were predominantly based in African countries. Therefore, these results may not be as applicable to

countries outside of this setting. This highlights the continued need for ongoing research in resource poor settings both within and outside of Africa. Significant heterogeneity in duration of follow-up, as well as when post-discharge mortality was assessed, was noted between the studies, potentially leading to a decreased ability to compare mortality rates. Many studies included in this review had high losses to follow-up (ranging between 0 and 39.3%), and very few were conducted prospectively with the stated intent of exploring post-discharge mortality. Studies with significant attrition due to follow-up likely under-estimate the true rate of post-discharge mortality as these losses undoubtedly represent a more vulnerable population. While one study focused on barriers to care following discharge among those children who died in the community, one important remaining gap is that studies did not evaluate the causes of post-discharge mortality, which is difficult to measure given that most deaths occur in the community (English et al., 2016; Wiens et al., 2015a). The ongoing, multi-country, Childhood Acute Illness and Nutrition (CHAIN) network, is attempting to understand the specific reasons for deaths post-discharge among malnourished children (The Childhood Acute Illness & Nutrition Network, 2017). It is through contributions such as this that further interventions can be developed and implemented that target the specific and causal factors affecting pediatric mortality rates in developing countries.

2.6 Conclusions

In conclusion, the studies identified emphasize the significant burden of post-discharge mortality in countries where overextended and resource-limited health systems serve millions of socioeconomically disadvantaged children. The scale of this burden continues to be under-recognized, in part due to the inability of health systems to observe patient outcomes after discharge. Addressing these issues with specific regard to the identification of vulnerable children, and the development of effective post-discharge interventions, will be an essential component towards the achievement of the child mortality targets of the sustainable development goals.

CHAPTER 3: Predictor Variables for Post-Discharge Mortality Modelling in Infants - A Protocol Development Project

Two-thirds of the five million children under five years old who die every year are under the age of one (GBD 2016 Mortality Collaborators, 2017). Most of these deaths occur in low and middle-income countries resulting from preventable infectious causes (Liu et al., 2015; Zupan, 2005). Thus, reducing the under-five mortality rate to less than 25 per 1000 live births by the year 2030 as targeted by the United Nations Sustainable Development Goals (SDG) relies on addressing this issue (United Nations, 2015b).

Mortality rates in the months following discharge are often equal to, or greater than during hospitalization (Wiens et al., 2013). Despite this burden, few studies have explored health seeking behavior and mortality or evaluated interventions in children following hospital discharge; none have implemented interventions to improve post-discharge outcomes. One proposed solution to improve post-discharge outcomes is through a precision health approach, whereby vulnerable children in resource-poor countries are identified prior to discharge, ideally at time of admission, through the use of prediction models (Wiens, Kissoon, & Kabakyenga, 2017). Using this approach, health systems are better able to deploy scarce resources and life-saving interventions to those most likely to benefit.

Optimal predictive models to inform health systems should be based on candidate predictor variables most likely to be associated with the outcome of interest (Hemingway, Riley, & Altman, 2009). The Delphi process is a well-recognized process that involves the solicitation of a panel of experts through two or more rounds of structured questionnaires, combined with review and modification by the research team (Hsu & Sandford, 2007). The goal is to acquire expert opinions from those outside the primary research team to optimize input and identify context appropriate variables for evaluation in predictor models.

A similar modified Delphi approach was used previously to determine candidate predictors for post-discharge mortality in the 6 months to 5 years age group, which led to a model derivation study and the subsequent development of the *Smart Discharge* intervention (Wiens, Kissoon, et al., 2016; Wiens et al., 2015b; Wiens, Kumbakumba, et al., 2016). However, models currently in use may not be applicable nor optimal for infants less than one year of age due to differences in

disease etiologies, physiology, vital signs, and presenting signs and symptoms. Using a similar approach to the prior variable selection process, the purpose of this project was to generate a comprehensive list of candidate predictor variables for infants less than one year of age. The variables identified will be used to derive prediction models for post-discharge mortality in newborns and young infants and will ultimately be included in an expanded *Smart Discharges* program for Uganda.

3.1 Methods

3.1.1 Design

A modified, two-round, Delphi process was performed to determine a potential set of candidate predictor variables for post-discharge mortality in infants less than one year of age. The inability to modify individualized responses based on the aggregate response was the modification to the standard Delphi process. Research Ethics Board approval was obtained from the University of British Columbia.

3.1.2 Participants

Participants were selected based on internal discussions by the primary research team. The desired expertise of participants included pediatrics, sepsis/infectious diseases, microbiology/laboratory medicine, global health, epidemiology, social sciences, neonatology and obstetrics. The target sample size was 25 individuals covering all areas of expertise, and to include multiple participants from the proposed research country, Uganda. The Delphi process does not include a required sample size or formal sample size calculation. However, it has been suggested that between ten and 50 participants may be ideal, although no consensus has been reached between authors and studies utilizing the methodology (Shariff, 2015). At the beginning of each round of the survey, experts were asked to self-identify their area of expertise, role, and affiliation (**Table 10**).

3.1.3 Process

The two-round modified Delphi process was conducted between August and November 2017 through the use of emailed surveys using Research Electronic Data Capture (REDCap) (Harris et al., 2009). The participants were given 14 days to respond for each round of the process. After each round, the primary research team determined whether or not the existing or suggested variable should be added, modified or removed, based on the survey responses and the research

team's knowledge of the study setting, Uganda. A final list of candidate variables was compiled by the research team following the results of the second survey. Since there was no direct interaction between participants, this was considered a modified Delphi process. However, during the second round of the survey, participants reviewed and critiqued the variables proposed in the first round. The first round further included general questions on expert-perceived rates and importance of post-discharge mortality as a public health issue in resource-poor countries (**Table 11**).

3.1.4 Round 1

An initial list of 37 candidate variables was generated by the research team through a systematic review of existing literature as well as the clinical experiences of the co-investigators (**Table 12**). This list included multi-part variables (e.g. anthropometric variables included mean upper-arm circumference (MUAC), weight and height, and associated z-scores). Experts were requested to evaluate the initial list of candidate variables based on (1) predictive value (2) measurement reliability (3) availability (4) applicability in low-resource settings. Those variables rated during the first round and selected as suitable for predicting risk in the specified population and setting (Uganda) were incorporated into the final list of candidate variables**Table 14**.

In addition to rating the candidate variables, participants were encouraged to comment on and suggest additional variables for inclusion in the second round. The research team considered each proposed variable and eliminated those considered redundant (e.g. malnutrition can be determined from MUAC or weight for age z-score). The revised list of potential candidate variables suggested through the first survey became the basis of the second round.

3.1.5 Round 2

The second round evaluated 27 new variables using the same criteria utilized in the first round. Participants were again encouraged to comment on each of the variables under evaluation. However, the second round disallowed for suggestion of further variables. The primary research team again utilized the results from the second round to retain, modify or eliminate the additional candidate predictor variables, and incorporated the selected variables into the final list of candidate variables.

3.1.6 Analysis

Each candidate variable was scored by participants as having (1) high, (2) moderate, (3) unlikely, or (4) no applicability for each of the four criteria previous described. Responses were tabulated and reported using descriptive statistics (Microsoft Excel, Seattle, WA). The proportion of respondents who scored a variable as highly applicable was of primary interest to the research team. The proportion of respondents indicating unlikely or no applicability was also of note.

3.2 Results

This modified Delphi process included 18 participants from low, middle and high-income countries (including Kenya, South Africa, Bangladesh, Malawi, Uganda, Canada, United States) (**Table 10**). These participants identified roles as physicians (12), nurses (2), clinical scientists (6), hospital administrators (1), and epidemiologists (5), with expertise in areas including pediatrics, infectious disease, global health, epidemiology, neonatology, and obstetrics. During the survey period, participants evaluated 37 candidate variables during round 1 (**Table 12**), 27 candidate variables during round 2 (**Table 13**), resulting in a final list of 55 candidate variables to be used for subsequent post-discharge mortality prediction modeling research (**Table 14**).

Eighty-nine percent and 83% of participants rated post-discharge mortality as 'very important' for children aged 0-1 months and children 1-12 months, respectively (**Table 11**). Ninety-four percent of experts surveyed thought that, in comparison to other public health issues in resource poor countries, the current allocation of resources for post-discharge care of children under the age of 1 was 'very inadequate'. Responses varied when asked about what they believed the post-discharge mortality rate was in the first 6 months following discharge for children admitted with an infectious illness in resource-limited countries. For children age 0-1 month, respondents generally believed mortality rates to be between 5% and greater than 10%. For children age 1 to 12 months, the majority chose between 2-10%.

3.2.1 Round 1

A total of 18 participants completed round 1 (**Table 10**). Each survey question received between 16 and 18 responses, out of a possible total of 18, since not every question received a response by each participant.

3.2.1.1 *Predictive Value*

Responses varied from "no applicability" to "high predictive value"; however, only two

variables (temperature and abdominal distension at admission) received a response indicating no applicability. The majority of responses ranged from “unlikely” to “high predictive value”. Those receiving the most responses (>70% of respondents) for high predictive value were: anthropometrics, coma score at admission, comorbidities (e.g. congenital defect, sickle cell anemia, tuberculosis) birth weight, number of weeks gestation at birth, HIV status (94%), immunization status, and number of previous hospitalizations. Gender and the number of siblings received less than 10% high predictive responses as well as the highest amount of responses for unlikely predictability. Those variables deemed to be the least predictive for mortality (>30% unlikely responses) included temperature at admission, jaundice at admission, and abdominal distention at admission. Comments made by participants indicated that predictive value for many variables may itself vary by the age of the child, with some being more pertinent for the younger infant and vice versa. For example, birth weight was indicated in a comment to potentially be more predictive in the younger neonate than in those approaching one year of age.

3.2.1.2 *Measurement Reliability*

None of the variables received responses indicating no applicability for measurement reliability (inter- and intra-rater reliability). High measurement reliability was indicated by at least 70% of expert respondents for the variables gender, HIV status, blood lactate level at admission, location of birth (home vs facility), birth weight, age, and oxygen saturation (SpO2) at time of admission. Furthermore, the variables rated as less reliable (i.e. fewer than 20% rated as highly reliable) included dehydration (using WHO dehydration scale), jaundice, multiple associated infectious symptoms and abdominal distension at admission, other comorbidities (e.g. congenital defect, sickle cell anemia, TB etc.), and number of weeks gestation at birth. Most variables received ratings of moderate measurement reliability. The variables receiving more than 30% responses for unlikely reliability included central cyanosis and multiple associated infectious symptoms at time of admission (e.g. pneumonia and diarrhea). Experts repeatedly commented that reliability would diminish when intense staff training is required for variables, or when recall of memory is needed in the face of unreliable or unavailable medical records.

3.2.1.3 *Availability*

No respondents rated any variable as being unavailable; responses varied between unlikely to high availability within low-resource settings. Those deemed highly unlikely to be available

were blood culture at admission (94%), blood lactate level at admission (88%), and oxygen saturation (SpO2) at time of admission (56%). Most available variables (as indicated by >75% responses as highly available) included signs and symptoms such as bulging fontanel, grunting, diarrhea and convulsions at admission, and location of birth (home vs facility), gender, number of siblings and mothers age. Excluding HIV testing, no respondents rated the proposed laboratory variables as highly available and instead overwhelmingly rated them as unlikely. Availability was considered as something that was mainly dependent upon consistency of supplies and training of personnel. Those variables requiring least supplies and training were regarded as highly available whereas those needing specialized equipment or supplies generally deemed as largely unavailable and increasing staff training were scored lower.

3.2.1.4 *Time and Material Resources Required*

Variable ratings varied from unlikely (high amounts of resources required) to highly applicable (fewer resources required); no variables were deemed to be absolutely unavailable in terms of time and material requirements. Those indicators receiving the highest applicability (fewest resources required) included mother's age (94%), age of the child (89%), sex (88%), convulsions at admission (89%), and chest indrawing at admission (89%). Overwhelmingly, laboratory variables (excluding HIV status) were those deemed to require the most time and material resources. Variables were overwhelmingly rated as requiring few resources; however, comments suggested that even when supplies themselves may have been deemed largely available (e.g. weight scale, thermometer), the need for maintenance and calibration precluded them from being rated as highly available in terms of time and material resources.

3.2.1.5 *Proposed New Variables*

Twenty-six new variables were proposed, which when separated into individual parts, and overlap and similarities removed, yielded the 27 variables included in the second round (**Table 13**).

3.2.2 Round 2

Participants comprised 17 of the 18 who completed round one, with the same self-described areas of expertise and roles (**Table 10**). Response rates for survey questions varied between 13 and 17 responses, out of a possible total of 17.

3.2.2.1 *Predictive value*

The 27 variables evaluated during the second round had varying perceived predictive value, ranging from no applicability to high applicability. Most responses indicated moderate predictability. The variables receiving the most scores of "high applicability" included the child's mother having died (88%), mother being chronically ill (e.g. HIV, TB, mental illness) (69%), and history of birth asphyxia (67%). Those variables receiving the lowest ratings for predictability with high response rates of "unlikely predictability" included mode of delivery, skin color at birth, and platelet count at admission. Health insurance coverage for the child was the only variable to receive modest ratings of no applicability by experts (27%). Expert comments suggested that predictive value for indicators may be influenced in some case by objectivity or subjectivity of the measure (e.g. pallor) as well as the specificity with which the predictor indicates mortality (e.g. the implications of the presence of hypotonia varies from insignificant to grave consequences).

3.2.2.2 *Measurement reliability*

The variables rated as having high measurement reliability by over 75% of respondents included mode of delivery, hemoglobin, and a deceased mother. Blood in stool (dysentery), duration of present illness, mode of delivery, history of resuscitation after delivery, lab values (including hemoglobin, platelet count, urea/creatinine, white blood cell count) at time of admission, mother deceased, acutely ill, or chronically ill (at time of admission), child covered under a health insurance plan, primary caregiver (at home or admission) other than mother, and mode of transport to health facility all had 80% of respondents rate it as having moderate to high measurement reliability. Oral/motor coordination impairment (53%), skin color at birth (67%), and parental substance use (44%) were largely rated as unlikely to be measured reliably. One variable (pallor at admission) was rated as having no predictive value by one expert only. Experts once again continued to comment on the important role of training requirements for staff (e.g. oral/motor coordination impairment) on measurement reliability and the potential impact of memory on variables (e.g. history of resuscitation) in settings where no medical record is available.

3.2.2.3 *Availability*

More than 75% of respondents rated primary caregiver (during admission) other than mother,

deceased mother as highly available. Laboratory values, including platelet count, urea/creatinine, and sickle cell/thalassemia status was not rated as highly available by any expert. Those receiving at least 85% of responses indicating moderate to high availability included the following at time of admission: pallor, hypotonia, spasticity, blood in stool (dysentery), history of cough for two or more weeks, duration of present illness, mode of delivery, mother is acutely or chronically ill, deceased mother, primary caregiver (at home or during admission) other than mother, and mode of transport to health facility. No variables received ratings indicating an absolute lack of availability. However, those consistently rated as unlikely (by greater than 60%) included urea/creatinine at time of admission, sickle cell/thalassemia status, and child is covered under a health insurance plan. Experts further commented that although variables may have predictive value, their availability limits the extent to which they are useful within low-resource settings.

3.2.2.4 *Time and Material Resources Required*

Those variables rated as requiring the fewest resources to acquire (by at least 70% of respondents) included information on a deceased mother and pallor at admission. All clinical and sociodemographic variables (excluding oral/motor coordination impairment, family wealth index and health insurance coverage), history of birth asphyxia, history of resuscitation after delivery, and umbilical care were rated highly (by at least 85% of respondents), indicating low to moderate amounts of time and material requirements. Although some variables were rated as requiring moderately few resources, many (especially laboratory variables) were rated to require large amounts of resources. Experts further emphasized that laboratory tests relied on resources that were not available in most resource-limited settings. Comments also indicated that amounts of resources required depended on diagnostic approaches; for example, confirmation of perinatal infection would be resource-intensive if it relies on culture techniques rather than on clinical signs and symptoms.

3.2.2.5 *Final list of candidate predictor variables*

The final list of 55 candidate predictor variables accepted through the modified Delphi process (**Table 14**) were identified through expert opinion together with real-time considerations of budget and availability at the proposed research site. The variables identified will be included in future research aimed at establishing prediction models in Uganda.

3.3 Discussion

A modified two-round Delphi process conducted using experts from a variety of relevant backgrounds yielded a list of 55 candidate predictor variables to be utilized in the development of a predictive model for post-discharge mortality in infants in resource-limited settings. The clinical presentation of infants is likely to differ from older children due to developmental characteristics and physiology; thus, assessment of risk requires an age-specific set of predictors. The differences between pertinent potential risk-factors for the infant versus the older child are further solidified based on variables selected during the Delphi process from all categories including clinical, laboratory, birth, and social/demographic, in comparison to those previously identified for the older child (Wiens, Kissoon, et al., 2016).

A major strength of this study is the inclusion of experts from multiple pertinent fields. The unique and relevant knowledge participants applied to their evaluation of proposed variables provided additional candidate variables not previously considered by the research team. The breadth of experience resulting from the inclusion of participants with a broad range of expertise also helped ensure that the identified indicators were appropriately evaluated within the clinical context in which they would be utilized. The participants' experiences, knowledge, and understanding of policies, practices, procedures, and availability of personnel and resources in the proposed research country ensured that selected variables are indeed practical for research and implementable within the proposed prediction models.

The selection of final candidate prediction variables was both objective and subjective, incorporating results of the Delphi survey process as well as the considerations of the primary research team in terms of relevance and feasibility. Availability at the proposed research site and resource requirements (including time, personnel, and monetary constraints) were central to the acceptance or elimination of proposed factors. For example, although 82% of respondents rated blood culture as having a moderate to high strength for predicting mortality, practical considerations at the proposed research site, as well as the unavailability of this variable as most of the targeted sites for future implementation, negated it from being an included variable. Furthermore, although a variable may have had a lower score for predictive value in the Delphi process, its easy accessibility and measurement may have enabled it to be included as a variable to be considered (e.g. mode of delivery).

The predictor variables identified through this modified Delphi process will be utilized in a model derivation study to predict death post-discharge in children less than one year of age, admitted with infectious illness. By doing so, the limited resources available may be channeled to those children at high-risk for mortality. The process outlined within this paper, coupled with the planned future research and derivation of prediction models, has been recognized as a form of precision public health (Wiens et al., 2017). Precision public health has been proposed as an ideal framework to utilize in decreasing post-discharge mortality, as it improves the efficacy of public health interventions through using precise data, focusing on those who would benefit the most. Although precision public health has started to gain momentum high income countries, its effect in low-resource countries has yet to be fully explored, and yet the potential to impact child mortality could be significant. If vulnerable children can be identified during the admission through the use of risk stratification, effective interventions can be developed and implemented to target those children. Ongoing work in Uganda, described as *Smart Discharges*, has demonstrated that using prediction to identify high-risk children, paired with interventions including comprehensive discharge teaching and referrals for routine follow-up, could potentially reduce mortality in children (6 months to 5 years of age) during the critical post-discharge period (Wiens, Kumbakumba, et al., 2016). As an extension of this work, the predictor variables identified within this process will focus on predictive modeling for children under one year.

There are several limitations of this study. A primary limitation of this process is the lack of participants' ability to modify responses based on the responses of other experts. Although discussion of specific variables among the experts was not available, an opportunity to comment on each variable was provided to facilitate any questions, comments, or further clarification needed by the variable definition proposed. These comments were seen by the primary research team and discussed, thus allowing the research team to carefully weigh decisions related to inclusion and exclusion of variables. Furthermore, the participants included experts from both developing as well as developed countries as a means of eliciting a wide range of expertise and viewpoints; however, not all experts had an in-depth or practical understanding of the clinical context within the proposed country of study. Expert responses, therefore, based upon their known context, may have resulted in variables being rated as having lower impact than they

actually do, and vice versa. While this diversity may have created some heterogeneity in responses, these diverse opinions, however, strengthened the ability of the research team to make informed decisions regarding the final list of candidate predictor variables.

3.4 Conclusion

The modified Delphi process contributed to the evaluation and identification of potentially useful predictor variables for post-discharge mortality among infants. It helped broaden the selection of variables obtained from a systematic review and brought objectivity and insight to aspects of predictive value, reliability, availability, and applicability in low-resource settings. The identified variables are a valuable starting point for the construction of a predictive model to identify at-risk infants, who may then be able to benefit from specific interventions aimed towards reducing mortality. Low-resource settings demand that the vulnerable be identified and resources allocated accordingly. The variables identified are an important step towards the goal of reduced childhood mortality.

CHAPTER 4: Social Justice in Global Health - A Concept Analysis

"The idea that some lives matter less is the root of all that is wrong with the world."
— Paul Farmer (Kidder, 2009, p. 294)

Two-thirds of the word's communicable diseases, prenatal and maternal mortality, and nutritional deficiencies are born by the poorest 1.2 billion people (Falk-Rafael, 2006). Research continues to link health disparity with social inequality, both nationally and internationally, yet the maldistribution of wealth and inequity within and between countries continues to increase (Boutain, 2005; Falk-Rafael, 2006). Ethics research has indicated that people are more likely to have sympathy for those who are close and familiar than for those who are different or further away (Anderson et al., 2009). Although not necessarily intentional, the lack of concern for the "different or distant other" at local, national, and global levels, contributes to massive health disparity (Anderson et al., 2009). It is primarily this problem of inequity both between and within nations that constitutes the issue of social justice in global health.

The fundamental responsibilities of nursing include the promotion of health, prevention of disease, and alleviation of suffering (Falk-Rafael, 2006). Often proclaimed as the founder of modern nursing, it was Florence Nightingales' vision for nursing that these fundamental responsibilities would be carried out by nurses both locally and on the international stage (Falk-Rafael, 2006). However, Nightingales' vision for nursing in a global and social context has not received sufficient attention (Falk-Rafael, 2006). Nursing's focus has shifted from caring for society to caring for individuals, in turn creating a worldview where health is not a societal concern, but a purely individual one (Boutain, 2005). It is from this context that nursing today lacks a holistic understanding of inequity and social justice, in particular as it pertains to global health.

Social justice as a concept, although defined in many ways at various times and by various individuals and professions, lacks clarity in its definition and role for nurses. Furthermore, an understanding of social justice must be expanded and re-defined within the context of global health if we wish to have an increased global nursing consciousness and commitment from the profession (Falk-Rafael, 2006). Nursing codes of ethics and professional literature affirm the responsibility of nurses to promote social justice (Grace & Willis, 2012). Social justice in global

health must be understood in order for nurses to make a substantial difference both on local and international stages. The complex concept of social justice has been widely discussed and debated within many disciplines; however, although a popular phrase, social justice literature has lacked substantial content in the area of global health nursing.

The purpose of this concept analysis is to examine the state of knowledge around social justice in global health within the nursing profession and provide required clarity to the concept. Using a modified Walker and Avant approach to concept analysis, a review of the literature will first contribute to an understanding of the current state of the concept from various pertinent disciplinary perspectives. A theoretical definition, antecedents, defining attributes, and consequences will be identified along with strengths, limitations, and gaps in current knowledge and understanding. Thereafter, a model case depicting all defining attributes will be presented, followed by direction required for further concept development. The analysis of social justice will provide a needed foundation of understanding for this integral and yet poorly understood topic in global health nursing, from which our profession may establish itself as a leader.

4.1 Literature Review

Nursing as a profession does not have all of the answers to promote social justice in global health; it is only through combining expertise, knowledge, and skills from other disciplines that the complex issue that is social justice can be realized (Bathum, 2007). This literature review draws from the disciplines of nursing, public health, social work, philosophy, law, international development studies, and religious studies to bring clarity to the concept.

4.1.1 Nursing

In nursing literature social justice has often been defined as concern for the equitable distribution of benefits and burdens within society, promoting equal living and health conditions, and often includes aspects of societal restructuring (Bathum, 2007; Boutain, 2005, 2011; Grace & Willis, 2012; Matwick & Woodgate, 2017). Bathum (2007) describes social justice as any change, large or small, that improves lives. One concept analysis defined social justice as "full participation in society and the balancing of benefits and burdens by all citizens, resulting in equitable living and a just ordering of society" (Buettner-Schmidt & Lobo, 2012, p. 954). A second concept analysis utilizing Walker and Avant's approach proposed social justice in nursing as "a state of health equity characterized by both the equitable distribution of services affecting health and helping

relationships… achieved through the recognition and acknowledgment of social oppression and inequity and nurses' caring actions toward social reform" (Matwick & Woodgate, 2017, p. 182).

The "upstream" concept has been used to define social justice work in nursing, which accounts for the many systems in which health is imbedded and then pushes for systemic change (Paquin, 2011). In simple terms, Paquin (2011) defines it as "aligning 'what is' and 'what should be' by becoming engaged in social and political issues that impact the health of the community and society" (p. 65). In an attempt to promote justice within society, moral privilege is given so that the needs of the vulnerable are met (Boutain, 2011). When discussing social justice, it is often equated with fairness or distributed justice; furthermore, there is frequently no differentiation made between social justice and distributive (equal allocation of goods) or market justice and neoliberalism (individual resources and choices determine distribution) concepts (Boutain, 2011). Current nursing literature tends to focus not on policy or institutional and community change, but on caring for persons after an injustice has occurred (Boutain, 2011). Within nursing education, aspects such as human rights, culturally-sensitive practice, critical thinking, and a global consciousness are emphasized (Boutain, 2011). Although social justice research focuses on care for the marginalized and vulnerable, it is seldom utilized as a framework to guide research (Boutain, 2011). The critical social perspective within nursing research has been suggested to contribute to social justice through participant empowerment with an end goal of social action and transformation; an "outside" or "etic" perspective cannot fully understand the meaning of what it is to be socially just within another culture or people without the complex perspective of that people themselves (Bathum, 2007).

Nurses have recognized a social obligation to determine assumptions and inequalities influencing health care and health care delivery, utilizing social justice to address social determinants of health (Boutain, 2011; Matwick & Woodgate, 2017). Nursing associations around the world incorporate aspects of social justice within their ethical documentation, whether explicitly stated or not (American Nurses Assocation, 2016; American Nurses Association, 2017; Canadian Nurses Association [CNA], 2017; International Council of Nurses, 2012; Nursing and Midwifery Board of Australia, Australian College of Nursing, & Australian Nursing Federation, 2008). However, after an analysis of social justice within many documents by the American Nurses Association [ANA], Valderama-Wallace (2017) suggested that more consistency in defining and

conceptualizing social justice would guide nursing to strategic mobilization through utilizing the authority and privilege of our large and influential profession. Although a single definition may not be plausible, an underlying consistency and coherence for social health within the global health context should be sought (Anderson et al., 2009).

4.1.2 Public Health

Public health identifies social justice as a responsibility, core ethical principle, and the moral justification for the profession (Drevdahl, Kneipp, Canales, & Dorcy, 2001; Grace & Willis, 2012). Supporting and advocating for social justice towards improved health for entire populations has also been identified as central to public health (Paquin, 2011). Drevdahl et al. (2001) once again define social justice as "a form of justice within which there is an equitable bearing of burdens and reaping of benefits in society" (p. 23). However, it has been argued that such a definition negates the root causes of injustice, and that an all-inclusive definition integrating practice, research, education, and policy has yet to be found (Grace & Willis, 2012). Social justice includes aspects such as equity, equality, moral 'rightness', is rooted in human well-being, and must be demonstrated by action (Drevdahl et al., 2001; Grace & Willis, 2012).

4.1.3 Social Work

Social justice has been identified as a central concept and value of social work, as well as its moral responsibility (Olson, Reid, Threadgill-Goldson, Riffe, & Ryan, 2013). Social change is pursued on behalf of oppressed and vulnerable populations, with efforts focused on confronting forms of social injustice such as poverty, unemployment, and lack of health care towards participation and equal opportunity (Olson et al., 2013). Although often cited as a broad and ambiguous concept, social justice in social work literature has been associated with ideas such as freedom, human rights, social responsibility, civil liberty, fairness, equality, equal opportunity and access to resources, advocacy, moral obligation, common good, empowerment, and confronting injustice (Olson et al., 2013). The defining characteristic between social and distributive justice is that it "… refers to a social rather than an individual obligation; involves meeting people's needs as a matter of justice rather than charity; and places responsibility on a central authority, presumably government, to redistribute resources and alleviate poverty, need, and inequality" (Olson et al., 2013, p. 25).

4.1.4 Philosophy

Justice finds its roots in ethics with its philosophical beginnings in the writings of Socrates, Plato, and Aristotle; it is through their contribution that ongoing discussion has followed, ultimately resulting in standards of society and just laws (Drevdahl et al., 2001). Socrates saw justice as happening when society is well-structured (Drevdahl et al., 2001). Plato identified social justice as the distribution of rights and responsibilities in the context of social relationships, and Aristotle defined it as each member of society having what they 'ought' to have (Drevdahl et al., 2001). Rawls's theory of distributive justice emphasized principles to benefit those who are least advantaged in society (Rawls, 1971).

4.1.5 Law

In the aftermath of World War II, the *Universal Declaration of Human Rights* outlines the idea of fundamental rights and that "… recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world" (United Nations General Assembly, 1948). It was a collaboration between the world's representatives and the first document to clearly define a set of fundamental rights to work towards and protect throughout the world. Article 25, 1 states:

> Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control. (United Nations General Assembly, 1948)

Racism, the environment, sexism, and relationships between first and third-world countries are some of the current social justice issues facing the legal profession (Buettner-Schmidt & Lobo, 2012). As a public health nurse, Drevdahl et al. (2001) explained that justice is not realized or fully explained within the law; there is a disconnect between what is legal and what is just.

4.1.6 International Development Studies

Development studies acknowledge the lack of a definition for social justice within their field (Helmy, 2013). Although not explicitly defined, social justice has been suggested as an approach to poverty and vulnerability reduction that recognizes both structural conditions as well as assets, capability, and power and can be conceptualized by terms such as "overcoming suffering" (Devereux & Mcgregor, 2014). Development studies is interested in human well-being and the

elimination of poverty in relation to social justice (Devereux & Mcgregor, 2014). From a historical concept analysis of social justice, justice was noticeably missing from both development academia and international organization's strategies for development until the early nineties when it gained attention in part from individuals such as Amartya Sen (Abdelhameed, 2016). The economist and philosopher Amartya Sen was among those who initially conceptualized social justice within 20th century development studies literature, arguing that development or well-being should not be measured based on income but rather on the capability of function, on the freedom to choose without political, economic, or social barriers (Helmy, 2013). Building on his work, the United Nation's Human Development Reports have increasingly promoted a human-centered understanding of global poverty (Devereux & Mcgregor, 2014). Social justice indices, which include some measure of health, have been proposed in an attempt to define and quantify countries, thereby giving form to achievable actions towards social justice (Helmy, 2013). One such tool, the "Social Justice Index", attempts to measure using quantitative and qualitative indicators, progress on issues of social justice in European Union (EU) member states (Schraad-Tischler & Schiller, 2016).

4.1.7 Religious Studies

For many people around the world, faith has a direct and large impact on what people believe, and therefore also on what people do and why they do it. Religious studies, including that of the Judeo-Christian tradition, have historical significance in their role in defining social justice. Social justice is found throughout Judeo- Christian doctrine as an underlying mission and moral issue (Judd, 2013). In 1840, the first known use of the term 'social justice' was within Catholic writings of the Jesuit Luigi Taparelli who defined it as a virtue encompassing acts towards common good and rectifying unfair treatment (Buettner-Schmidt & Lobo, 2012; Grace & Willis, 2012). In 1967, Pope Paul VI created the Justice and Peace Commission with the goal of addressing social injustice on the global scale as he believed that extreme international disparity at multiple levels is a threat to peace and that there is a duty to pursue social justice (Buettner-Schmidt & Lobo, 2012). Although the term 'social justice' was a rather recent addition to the Christian lexicon, the concept of 'Imageo Dei', human beings in the image of God, is a fundamental and core doctrine within the Judeo-Christian tradition. Thus, the Christian tradition declares human life as sacred, and it is from this belief that it calls for the treatment of others

with equal moral concern and not as though a possession or means to an end (Grace & Willis, 2012). Christian tradition has asserted that assisting the vulnerable and marginalized of society through actions of mercy and compassion are acts of social justice that correspond to an idea of accountability and service to God (Potgieter, 2011; Tveit, 2013). The Old Testament states in Isaiah 1:17, "learn to do good; seek justice, correct oppression; bring justice to the fatherless, plead the widow's cause," representing one of many Biblical texts relating to an idea of social justice towards the vulnerable of the ancient world (*The Holy Bible: English Standard Version (ESV)*, 2001). Historically, key figures within the Judeo-Christian tradition, motivated by their faith, have been instrumental advocates for social justice by supporting causes such as the abolition of the slave trade, civil rights, and peace movements (Judd, 2013). A gap in the current literature is the lack of criteria and consensus for defining what social justice is and looks like; one suggestion is that a moral standard for what is just can be gained from spiritual traditions found in faith (Judd, 2013). Although Christians may agree on the importance of social justice, there remains a lack of consensus on the best way to achieve it, particularly in regards to what role should be played by the individual versus the church versus the state.

4.2 Analysis

4.2.1 Theoretical Definition

The literature reviews' exploration of the concept of social justice through the lenses of nursing, public health, social work, philosophy, law, international development studies, and religious studies have made it clear that there are many similarities and differences both between and among relevant disciplines. However, although literature discusses social justice, it is also clear that literature examining social justice within the context of global health has been lacking.

Social justice in global health nursing is a fundamental human right to be protected, a moral obligation demonstrated by action, and results in change that improves the health of individual lives and populations both locally and internationally by recognizing and confronting injustice, oppression and inequity, and promoting participation, opportunity, justice, equity, and helping relationships.

4.2.2 Antecedents

An antecedent is an event, incident, or situation that must be in place prior to the concept; it must pre-date the concept (Walker & Avant, 2010). The antecedents identified for social justice in

global health include health disparity, oppression, caring, and social responsibility and action. Health disparity and oppression preclude social justice in global health, as these factors provide the drive for change that social justice demands. Without these factors, there would be no need for social justice. Caring includes caring for a patient, for situations, and for societies as a whole, and provides the motivation to act upon situations of health disparity, injustice, and oppression (Matwick & Woodgate, 2017). Social responsibility and action are necessary for social justice to be realized and involves the actions of individuals and societies at large working in collaboration towards the common goal of social justice in global health.

4.2.3 Defining Attributes

Defining attributes allow one to easily identify the concept, as they encompass the core of a concept (Walker & Avant, 2010). Defining attributes of social justice in global health include 1) equity in opportunity for health, and 2) caring and cooperative societal relationships. Equity in opportunity for health includes aspects such as distribution of power and resources as well as the presence of just institutions, systems, policies, and processes (Buettner-Schmidt & Lobo, 2012). Caring and cooperative societal relationships are both between and within countries and societal groups. Caring represents the necessary drive to action, and cooperation is realized through political/social/individual responsibility and will to drive the necessary change.

4.2.4 Consequences

Consequences indicate the result of a concept, or the outcomes that occur when the concept is realized (Walker & Avant, 2010). The consequences of social justice in the global health context are health equity, safety and security, and adequate social determinants of health, both between and among countries and societies.

4.2.5 Strengths, Limitations, and Gaps

Using a modified Walker and Avant approach to concept analysis presents a concept in a positivist way; that is, one that can be defined, is objective, and applicable to all situations. However, the idea that a one-size-fits-all definition of social justice for global health is open to discussion, as it may not be an ideal fit for this concept due to the wide range of definitions and context for social justice, as well as what may be defined as “global health”. The literature review on social justice revealed many definitions and aspects of the concept, with noticeable differences between disciplines and through time. Throughout the literature, social justice has

often been equated with distributive justice; however, it continues to be imperative that a clear distinction be made between the two. Issues of social justice in global health are ongoing, and although many organizations, institutions, and professions acknowledge a social justice priority, what that means practically has yet to be defined and it is unclear as to how to actualize a vision of social justice (Anderson et al., 2009). Furthermore, nursing itself has been largely silent within this scope, even in the midst of the many global health crisis's and challenges ongoing throughout the world. Global health literature, particularly from the nursing perspective, has yet to delve into the issue of clarifying social justice and developing an operational definition.

4.3 Model Case

A model case demonstrates all of the defining attributes of social justice in global health as a concept, and will assist in bringing understanding and meaning to the concept.

Mary Ayebare is a 24-year old woman living in a rural South-Western Ugandan village with her husband and two young children. In 2017, her two-year-old son became ill during the rainy season; however, she had no money to pay for transport to take her son to the local health center and her husband was away working. Without a way to contact him, Mary could not ask for the money required to take her son to seek medical treatment. Mary decided to stay in the village and use traditional healing practices; however, when the child's health continued to deteriorate, the village chairperson came to her and provided the necessary funds from the community treasury to take the child to the health center IV, a 30-minute boda boda (motorcycle) ride away. Upon reaching the health center, her son was found to have severe malaria, requiring higher level of care than the health center could provide. Mary was referred to the government-run regional referral hospital where her son received treatment by the top doctors in the country with the support of volunteer ex-patriate medical staff. A phone had been sponsored at the pediatric ward of the hospital by a local non-government organization (NGO) so that caregivers without phones of their own could contact family members. Mary was able to contact her husband with the use of the sponsored phone and he then traveled to the health center to be with his family and provide the finances required for the treatments not covered by the public sector. Mary's son recovered from severe malaria and was discharged by the medical staff. The family was provided with discharge teaching and a referral letter to follow-up with her local health center in one week's time in order to ensure the child's health had continued to improve. The referral letter

was paired with enough money for transportation in order to ensure that follow-up could be completed by Mary and her son. Mary and her son were able to attend the follow-up appointment near her village, and her son was cleared of malaria.

This model case demonstrated both equity in opportunity for health and caring and cooperative societal relationships. Although Mary, as a young mother in rural Uganda and without access to her own finances, would have been unable to seek medical attention for her child, caring and cooperative societal relationships led to equitable access for health. Community treasuries were utilized and allocated appropriately by the local chairperson, who provided the initial funding for Mary to be able to take her son to the health center. From there, a government-run hospital provided free services by local and ex-patriate staff, funded by both the Ugandan Ministry of Health as well as overseas partners who recognize the need for publicly accessible higher levels of care that can provide quality care regardless of ability to pay. Ex-patriate medical staff provide support to local staff, empowering them to be able to serve their own people and provide adequate care. Furthermore, initiatives that have the potential to make a significant difference in the health outcomes of patients (such as a phone made available to patients and caregivers), are seen as important, and organizations, individuals, and institutions, both locally and internationally, partner with local facilities to provide those needed services. Finally, units are strengthened (e.g. family units, community processes) through programs that utilize the recognized strengths within individual societies.

4.3.1 Direction for Further Development and Analysis

This concept analysis of social justice in global health has identified several areas for further development. Although social justice has been explored and defined by many disciplines and fields, further development within global health, particularly from a nursing perspective, is required. Furthermore, development of an operational definition for social justice in global health nursing could provide a basis from which to expand our global health presence. One article identified difficulty with operationalizing social justice for nursing practice in a particular context, showing that the concept is generally one that has been largely difficult to define and operationalize (Anderson et al., 2009). However, identification of indicators which would assess progress towards social justice in global healthcare is necessary, especially for a practice profession such as nursing (Anderson et al., 2009). Furthermore, although nursing continually

includes social justice within its ethical documents, it has yet to be realized by the nursing profession in a way that makes it a priority. Questions including 'What is nursing's contribution to social justice within the global health context?', and 'How can professional associations support nurses pursuing social justice in global health?' could be explored through both qualitative and quantitative lenses, providing a direction for nursing in its commitment to social justice, particularly on the global platform.

4.4 Conclusion

Pertinent limitations of this concept analysis include the lack of an exhaustive systematic literature review; pertinent disciplines within which to investigate the literature on social justice were limited to the writers' ascertainment of applicability and transferability to the realm of nursing and global health. Although pertinent disciplines or articles may have been excluded due to this, reference lists of included articles were scanned in order to identify additional relevant articles which had not been found by the initial literature search. Furthermore, included literature was limited to those published in the English language, which may have also excluded articles of relevance to the topic.

Although social justice has been a topic of discussion among many disciplines, there has been a lack of significant content from the nursing perspective for the global health context. However, literature from nursing, public health, social work, philosophy, law, international development studies, and religious studies were reviewed, revealing both similarities and differences in definitions, along with an overall consensus that global health has not received attention within social justice discourse. This concept analysis has sought to discover the antecedents, defining attributes, and consequences of social justice in global health for nursing. It is from this beginning that nursing can be encouraged to engage with social justice and advocacy globally, moving our practice from one confined by the hospital walls to the global platform (Paquin, 2011). A firm understanding of social justice in global health can enable nurses to be agents of social change (Boutain, 2005). Florence Nightingales' legacy is one of nursing praxis in the global community (Falk-Rafael, 2006). It is time for nursing to re-enter the global health dialogue, bringing the unique nursing perspective to policies and practices pertinent to social justice in global health. As the largest group of healthcare providers globally, nursing has the responsibility and political potential to mediate change, addressing factors integral to ensuring

social justice in global health (Falk-Rafael, 2006; Grace & Willis, 2012).

CHAPTER 5: Conclusion

The world has dedicated itself to seeing the Sustainable Development Goals realized by the year 2030. A key aspect of the third goal is reduction of under-five mortality, a huge burden of which is borne by the world's most resource-limited countries. This thesis has examined the extent and role of pediatric post-discharge mortality, with a specific emphasis on Uganda. The common perspective of critical social theory informed and linked each chapter, as sections discussed and addressed issues pertaining to power, inequity, structural constraints, and oppression as they relate to the health of children discharged from hospital in countries often labelled as "developing". The ultimate goal throughout each chapter was to promote critical thought, reflection, change, and ultimately justice for the many children who continue to die unnecessarily. For the nursing profession as well as other medical professions, CST provides one way to decrease the theory-practice gap, as it strengthens linkages between knowledge and theory towards implementable social action for improved health.

The systematic review presented in Chapter 2 updated the base of current literature on the topic of pediatric post-discharge mortality, highlighting that although there has been additional evidence gained in the past few years, overall evidence remains limited. Many low-resource countries lack the ability to track pediatric deaths after discharge; furthermore, there has been relatively little furthering of research in these settings towards that end. An estimate of the rates of PDM, possible risk factors for mortality, and an idea of where children typically die and timing of the same, whether at home or upon a readmission, was gained through the review. The large number of children who die at home is partly a reflection of the strained healthcare systems, with a lack of beds, healthcare providers, and supplies accessible to these children. Moreover, many healthcare systems in low-resource settings continue to provide care to millions of people using outdated, old, and insufficient supplies, while developed countries have access to electronic and state-of-the-art equipment. The review further emphasizes both the importance and the opportunity that research into this area represents. Further high-quality, large-scale research is vital to begin to understand the entirety of the situation, from which sound and informed interventions may be proposed. However, many researchers in low-resource settings often have difficulty securing the funding required for needed large-scale studies, as funders frequently support projects reflecting the priorities of the developed world.

The Delphi study presented in Chapter 3 built upon the current knowledge of the topic presented in Chapter 2. From the context of the risk factors identified through literature, expert opinion was utilized in the modified two-stage Delphi process, resulting in the identification a set of potential predictor variables for infant post-discharge mortality for Uganda as a specific study context. Many potential variables were identified and evaluated through the Delphi process, most of which ultimately represent those children growing up in extreme poverty and conditions associated with the same. Malnutrition, poor water sources, largely preventable diseases such as malaria and typhoid, a lack of education around health and well-being, and so much more are direct results of the absolute poverty that a staggering number of children in low-resource countries, including Uganda, continue to experience. These conditions have been targets to eliminate for years, and yet social constraints, corruption, maldistribution of wealth, and oppression of women and minorities are only some of the barriers which continue to perpetuate poor health for millions of children worldwide.

Identifying possible predictor variables is an integral component to understand and identify which young children are at highest risk for death so that targeted interventions can be implemented. Interventions must be applicable and plausible in the settings that these children are found, meaning that many children still continue not to receive a level of care comparable to that in high-income or "developed" countries. Simply due to place of birth and the cycle of poverty imposed upon their family, children are unable to receive the standard of care that many people identify as a basic human right, and which has been formally identified as such under the UN Convention on the Rights of the Child (United Nations, 1989). Health and human rights are inequitably linked (International Council of Nurses, 2009). Although many development agencies, non-government organizations, governments, individuals and charities may contribute to programs that strive to aid these children, the fact remains that there continues to be grossly insufficient funds dedicated to assisting the millions of children faced with extreme poverty and its associated consequences. This, in itself, is an issue of social justice for the children who continue to suffer and die daily and, often, unnecessarily. One child is not worth more or less than any another, and yet every day a child's worth is in essence assigned based on what people are willing to allocate to their needs, on what resources they have access to, and in turn, whether or not they will have the chance to survive an illness and recover fully.

Social justice is one of many concepts that underlay and is interwoven with the many ideas presented throughout this thesis; ideas of Social Determinants of Health, high mortality, and risk factors for death in children after discharge in low-resource settings. Although social justice is an often-discussed topic across many disciplines, nursing in particular has often lacked a perspective of social justice towards global health, in part due to nursing's overall lack of solid presence on the global health stage (International Council of Nurses, 2013). The concept analysis of social justice in global health presented in Chapter 4 represents an overall look at the topic, particularly as it pertains to the nursing profession. A thorough understanding of the concept is a necessary platform from which nursing may collectively stand and act as agents for change both nationally and internationally. Florence Nightingale, as modern nursing's founder, envisioned nursing as being fully engaged in the global community, with those who nursing could serve no matter what country they call home. Nursing has the potential and responsibility to be a part of global change.

5.1 Application and Future Direction

The research presented represents only one part of a whole; a small aspect of much larger research aiming to impact the health and of children in Uganda. This research has provided the necessary evidence base and support to justify pediatric post discharge mortality as a major issue in developing countries, an issue that requires action. It is from this basis that research in Uganda may continue, towards the eventual implementation of nation-wide interventions and discharge protocols, with the end-goal of saving the lives of children during the critical post-discharge period.

The work presented in this thesis has not only established a basis for further research and inquiry but has also highlighted the need for capacity building within many low-resource contexts. The relative lack of information on children who die after discharge in many countries underscores the need for national surveillance systems which would capture these children, give a true picture of the problem, and then also provide the data necessary to track progress. Prediction models for young children using the identified risk factors for the specific context of Uganda must be first derived and then tested. Ongoing work in Uganda will continue to this end, and has shown success with prediction model use in older children (Wiens, Kumbakumba, et al., 2016). Key to implementing usable, applicable, and effective interventions to combat these unnecessary deaths

is the understanding of the current health system and discharge process. Current research in Uganda is attempting to understand, from various health care perspectives, what the discharge process looks like at the hospital level, and what local practitioners identify as strengths and areas for growth and development. Together with local health systems, discharge interventions may then be identified and then tested, with an end-goal of preventing the many deaths in children that happen after being discharged from hospital. Much of this research is required, not only for Uganda, but for many other low-resource settings as well, as they may then identify implementable context-specific interventions towards change.

Capacity building is an important aspect of any level of change, especially when that change will influence the health systems of communities and nations. Increasing community engagement, strengthening competencies, adapting guidelines to the resources available, using innovative technology, and strengthening transport and referral processes are some of several factors identified by Kissoon and Carapetis (2015). These, together with complete integration of the health system, are required if children are going to be able to access the care they require and avoid falling through the cracks of a fragmented and broken system. It will require collaboration between policy makers, private and public health sectors, non-government organizations, and individual health practitioners; not a small feat, and yet necessary if real change is to be realized.

The nursing profession must take a leadership role on the national and international stages. Nurses make up the greatest number of health professionals, and thus have an opportunity to significantly impact all areas within the reach of our profession, a profession that crosses all borders. Nurses are respected and have a voice in society, one that needs to be used to intercede and advocate for those who have none. Pediatric post-discharge mortality presents an opportunity for nursing to advocate for these children, to strengthen the health systems that care for these children, and to tear down the barriers to health that they continue to face. Nursing can bridge the gap between individual patients and the greater healthcare system. Our profession can educate, empower, support, and aid children and families towards better health. However, it cannot be done by only those nurses working directly in low-resource contexts, as they often face shortages of resources, lack of adequate compensation, and staggering patient-to-nurse ratios that render them unable to provide the care children require. Nurses everywhere must come alongside one another, working together and with members of the greater healthcare, political, and global

community, to create a context where children are able to learn, grow, and live to become productive members of their societies.

5.2 Conclusion

Children continue to die unnecessarily and in staggering, under-recognized numbers, particularly in countries where strained and resource-limited health systems attempt to assist millions of socioeconomically disadvantaged children. Addressing these issues, identifying the most vulnerable children, and developing effective interventions is essential for achieving the SDGs outlined by the United Nations. Every day nurses as key members of health care teams around the world play a critical role in the health and wellbeing of patients, families, communities, and nations. Nursing has a vital role to play in not only addressing childhood post-discharge mortality, but in global health issues as a whole. It must be a concerted effort on all parts, from the health care teams, to policy makers, community leaders, researchers, and funders.

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Table 1: World Health Assembly Resolution on Sepsis Recommendations

WHA Urges to Member States (Seventieth World Health Assembly, 2017)*:	
(1)	to include prevention, diagnosis and treatment of sepsis in national health systems strengthening in the community and in health care settings, according to WHO guidelines
(2)	to reinforce existing strategies or develop new ones leading to strengthened infection prevention and control programmes, including by strengthening hygienic promoting hand hygiene, and other childbirth practices, infrastructure, infection prevention and control best practices, clean improvements in sanitation, nutrition and delivery of clean water, access to vaccination programmes, provision of effective personal protective equipment for health professionals and infection control settings
(3)	to continue in their efforts to reduce antimicrobial resistance and promote the appropriate use of antimicrobials in accordance with the global action plan on antimicrobial resistance, including the development and implementation of comprehensive antimicrobial stewardship activities
(4)	countermeasures to develop and implement standard and optimal care and strengthen medical for diagnosing and managing sepsis in health emergencies, including outbreaks, through appropriate guidelines with a multisectoral approach
(5)	to increase public awareness of the risk of progression to sepsis from infectious diseases, through health education, including on patient safety, in order to ensure prompt initial contact between affected persons and the health care system
(6)	to develop training for all health professionals on infection prevention and patient safety, and on the importance of recognizing sepsis as a preventable and time-critical condition with urgent therapeutic need, and of communicating with patients, relatives and other parties using the term “sepsis” in order to enhance public awareness
(7)	to promote research aimed at innovative means of diagnosing and treating sepsis across the lifespan, including research for new antimicrobial and alternative medicines, rapid diagnostic tests, vaccines and other important technologies, interventions and therapies
(8)	to apply and improve the use of the International Classification of Diseases system to establish the prevalence and profile of sepsis and antimicrobial resistance, and to develop and implement monitoring and evaluation tools in order to focus attention on and monitor progress towards improving outcomes from sepsis, including the development and fostering of specific epidemiologic surveillance systems, and to guide evidence-based strategies for policy decisions related to preventive, diagnostic and treatment activities and access to relevant health care for survivors
(9)	to engage further in advocacy efforts to raise awareness of sepsis, in particular through supporting existing activities held every year on 13 September in Member States
WHA Requests the Director-General:	
(1)	to develop WHO guidance including guidelines, as appropriate, on sepsis prevention and management

(2)	to draw attention to the public health impact of sepsis, including by publishing a report on sepsis describing its global epidemiology and impact on the burden of disease, and identifying successful approaches for integrating the timely diagnosis and management of sepsis into existing health systems, by the end of 2018
(3)	to support Member States, as appropriate, to define standards and establish the necessary guidelines, infrastructures, laboratory capacity, strategies and tools for reducing the incidence of, mortality from and long-term complications of sepsis
(4)	to collaborate with other organizations in the United Nations system, partners, international organizations and other relevant stakeholders in enhancing access to quality, safe, efficacious and affordable types of treatments for sepsis, and infection prevention and control, including immunization, particularly in developing countries, while taking into account relevant existing initiatives
(5)	to report to the seventy-third World Health Assembly on the implementation of this resolution

*(Seventieth World Health Assembly, 2017)

Table 2: Patients, Interventions, Comparisons, Outcomes, Study design (PICOS)

Population	Pediatric patients discharged from hospitals in developing countries, as defined as those countries currently (2016) classified by the United Nations Development Program (UNDP) as having a low Human Development Index plus those countries included previously (2011) as having a low Human Development Index (Jahan, 2016; Klugman, 2011)
	Exclusion criteria: • No pediatric data or pediatric data not differentiated from adult populations • No post-hospital discharge information or patients not discharged from a hospital setting • Discharge was following a non-admission (e.g. following birth) • Studies representing a specific non-infectious disease population where post-discharge care and outcomes would likely be different than that following acute (primarily infectious) illness including: • Surgical population • Specific congenital disease (cardiac, renal, etc.) • Cancer • Specific non-infectious admission including trauma, kidney disease, cardiac disease, ophthalmic disease, sickle cell disease, liver disease, epilepsy, burns, poisoning, asthma, etc. • Study was unpublished, published only in abstract form or in a language other than English, or provided no original data
Interventions	Studies may or may not include an interventional arm (i.e. both arms of an RCT will be included)
Comparisons	N/A
Outcomes	Primary Outcome: • Post-discharge mortality assessed greater than seven days following discharge Secondary Outcomes: • In-hospital mortality • Risk factors for post-discharge mortality
Study Design	Eligible study designs include the following: • Randomized control trials (RCTs) • Prospective or retrospective cohort studies • Studies utilizing surveillance data • Study designs which include a population discharged and then followed-up (including case-control, mixed-methods)

Table 3: Study Characteristics

Author ID	Years of Study	Country	Design	Facility Type	Population	Number of subjects	Age Range	Age estimate and dispersion (months): mean (SD) or median (IQR)	Female Proportion (%)
All Admissions/Unspecified Infectious Admissions									
(Veirum et al., 2007)	Jan 1991 - Dec 1996	Guinea-Bissau	Prospective cohort	National Referral Hospital	All admissions	3373	<6y		
(Moisi et al., 2011)	Jan 2004-Dec 2008	Kenya	Retrospective cohort	District Hospital	All admissions	10277	<15y		
(Wiens et al., 2015a)	March 2012 - Dec 2013	Uganda	Prospective cohort	Regional Referral Hospital	Proven or suspected infection	1307	6m-5y	18.10 (10.8-34.6)	45.1
Malnutrition									
(Hennart et al., 1987)	1970	Democratic Republic of the Congo (Zaire)	Prospective cohort	Hospital	Severe protein-energy malnutrition	171	0-6+y	Mean=46	
(Kerac et al., 2014)	July 2006-March 2007	Malawi	Prospective cohort	National Referral Hospital	Malnutrition	1024	5-168m	21.5 (15.0-32.0)	47
(Chisti et al., 2014)	April 2011-June 2012	Bangladesh	Prospective cohort	Hospital	Severe malnutrition and radiological pneumonia	405	0-59m	10 (5-18)	44.2
					Severe acute malnutrition- placebo	891		10.8 (6.9-16.7)	48
(Grenov et al., 2017)	March 2014 - Oct 2015	Uganda	RCT	National Referral Hospital	Severe acute malnutrition- probiotics	200	6-59m	17.5 (8.5)	42.5
					Severe acute malnutrition- placebo	200		16.5 (8.4)	42.5
Respiratory Infection									
(West, Goetghebuer, Milligan, Mulholland, & Weber, 1999)	May 1992 - Nov 1994	The Gambia	Case-control	Hospital	Acute lower respiratory tract infection (ALRI)	118	<5y	Mean= 9.7	43.2
(Villamor	1993-1997	Tanzania	Prospective cohort	Hospital	Pneumonia	687	6-60m	17.6 (12.1)	45.8

et al., 2005)									
(Ashraf et al., 2012)	Sept 2006-Nov 2008	Bangladesh	Prospective cohort	Hospital	Severe pneumonia	180	2-59m	7.3 (6.8)	34.4
(Reddy et al., 2014)	Nov 2008 - July 2009	Tanzania	RCT	Regional Referral Hospital	Tuberculosis- standard diagnostics	10	<6y	21 (5-47)	70
					Tuberculosis- intensified diagnostics	13		10.5 (6.0-18.0)	38.5
(Chhibber et al., 2015)	May 2008-May 2012	The Gambia	Prospective cohort	Health Center	Pneumonia, sepsis, or meningitis	3952	2-59m		
(Ngari et al., 2017)	Jan 2007- Dec 2012	Kenya	Prospective cohort	District Hospital	Severe pneumonia	2461	1-59m	9.3 (3.9-20.4)	43.2
					No pneumonia	5270		19.5 (11.0-28.5)	43.6
(Newberry et al., 2017)	April 2012-Aug 2014	Malawi	RCT	Hospital	Pneumocystis jiroveci pneumonia (PJP)--- intervention (corticosteroids)	36	2-6m	3.1 (2.7-3.9)	66.7
					PJP--- placebo	42		3.4 (2.9-4.4)	50
Diarrhea									
(Roy et al., 1983)	1979-1980	Bangladesh	Prospective cohort	Health Center	Diarrhea	551	3-36m		
(Stanton, Clemens, Khair, & Shahid, 1986)	Oct 1983-Dec 1983	Bangladesh	Retrospective cohort	Hospital	Diarrhea	112	24-72m		27
(Islam et al., 1996)	Nov 1991 - Dec 1992	Bangladesh	Prospective cohort	Hospital	Diarrhea	427	1-23m		39.1
Anemia/Malaria									
(Zucker et al., 1996)	Mar 1991-Sept 1991	Kenya	Case-control	District Hospital	Anemia (case)	293	<60m	9.8 (8.6)	50
					No anemia (control)	291		13.5 (11.3)	50
(Biai et al., 2007)	Dec 2004-Jan 2006	Guinea-Bissau	RCT	National Referral Hospital	Malaria- intervention	460	3-60m	24 (13-36)	45.4
					Malaria- no intervention	491		24 (14-39)	43
(Phiri et al., 2008)	July 2002-July 2004	Malawi	Longitudinal case-control	Hospital	Severe anemia	377	6-60m	20.4 (12.8)	53.6
					No anemia	377		22.5 (12.1)	47.7
(Phiri et al., 2012)	June 2006-Aug 2009	Malawi	RCT	Hospital	Severe malarial anemia	1414	4-59m	23.9 (13.4)	51.6
(Olupot-Olupot et	2014	Uganda	RCT	Hospital	Severe anemia- higher blood transfusion	78	60d-12y	31 (11-48)	51

al., 2014)					volume (30ml/kg)				
					Severe anemia-standard blood transfusion volume (20ml/kg)	82		36 (19-54)	50
(Opoka et al., 2016)	Nov 2008 - Oct 2013	Uganda	Prospective cohort	National Referral Hospital	Cerebral malaria	269	18m-12y	3.9 (2.7-6.0)	35.2
					Severe malarial anemia	233		2.8 (2.1-3.9)	39.9

SD, standard deviation; IQR, inter-quartile range; RCT, randomized control trial.

Table 4: Outcome Characteristics

Author ID	Intervention/ Exposure	IPM (%)*	Follow-Up Times	Loss to Follow-Up (%)*	PD Re-Hospitalized (%)*	PDM (%)*	Place of PD Death	PDM Statistics (in weeks) **
All Admissions/Unspecified Infectious Admissions								
(Veirum et al., 2007)		15	Days 1, 14, 30, 91, 182, 365	--		8	77% at home 23% in hospital	63% at 13w
(Moisi et al., 2011)		--	1 year	--	17.7	5.2		
(Wiens et al., 2015a)		4.9	2, 4, 6 months	1.7	16.5	4.9	67% out of hospital 33% in hospital	50% at 4w
Malnutrition								
(Hennart et al., 1987)		--	Every year for 5 years	--		15.9		59% at 52w
(Kerac et al., 2014)		23.2	90 days and 1 year	17.2	6.62	24.0		44% at 13w
(Chisti et al., 2014)		8.6	Weekly for 2 weeks then monthly until 6 months	15.0		8.7	80% at home 16% in hospital 4% on transport	59% at 4w 88% at 9w
(Berkley et al., 2016)	Oral co-trimoxazole prophylaxis	3.4	Once per month until 6 months, then once every 2 months until 12 months	5.3	296 non-fatal admissions	11.1	32% in readmission to a study hospital 15% in other hospitals 53% in community	
	Placebo			5.1	320 non-fatal admissions			
(Grenov et al., 2017)	Probiotics	11.5	At 8-12 weeks	10.4		1.8		
	Placebo	8.0		7.9		2.4		
Respiratory Infection								
(West et al., 1999)	Hypoxemia	--	Mean length of follow-up 41 months	36.1		9.6		
	Non-hypoxemic	--	Mean length of follow-up 34.1 months	39.3		3.7		
(Villamor et al., 2005)		3.1	Every 2 weeks for a year then every 4 months Mean duration of follow-up 24.7 months (SD = 12.3, median = 28.2)	11.4		10.4		80% by 52w
(Ashraf et al., 2012)		0	Every 2 weeks for 3 months	6.4	6.4	1.7		
(Reddy et al., 2014)	Standard and Intensified diagnostic arms	--	2 and 8 weeks post enrollment	--		17.4		50% at 2w "post-enrollment deaths"; IP or PD

	analyzed together							not specified
(Chhibber et al., 2015)		3.9	180 days	--		2.8		55% at 6w
(Ngari et al., 2017)	Pneumonia	5.6	Every 4 months until 1 year	1.9		3.1	37% in hospital	44% at 13w 74% at 26w
	No pneumonia	2.4		0.9		1.3		
(Newberry et al., 2017)	Corticosteroids	27.8	1, 3, 6 months	11.5		19.2		
	Placebo	52.4		10.0		35.0		
Diarrheal Diseases								
(Roy et al., 1983)		--	Monthly for 12 months	--		4		52% at 4w 70% at 9w
(Stanton et al., 1986)		1.8	At 4-5 months	6.8		2.9		
(Islam et al., 1996)		14.6	At 6 and 12 weeks	--		7.5		94% at 6w
Anemia/Malaria								
(Zucker et al., 1996)	Anemia	13	4 and 8 weeks	4.0		18.8		
	No anemia; figures include the analyzed "no-anemia cohort" from study plus additional children	9		4.0		10.3		
(Biai et al., 2007)	Intervention: improved management and free emergency drugs for malaria, financial incentive	4.6	28 days	3.9		1.8		
	Control	9.4		4.9		0.9		
(Phiri et al., 2008)	Severe anemia	6.4	1, 3, 6, 12, 18 months	17.8	18.1	11.6		71% at 26w
	No anemia	0		19.6	9.3	2.7		60% at 26w
(Phiri et al., 2012)	Artemether–lumefantrine	--	1, 3, 6 months	5.0	21.5	2.5		50% at 4w
	Placebo	--		4.9	24.4	2.3		50% at 9w
(Olupot-Olupot et al., 2014)	Severe anemia-higher blood transfusion volume (30ml/kg)	0	28 days post-admission	0		1.3		

	Severe anemia-standard blood transfusion volume (20ml/kg)	7.3		0		0		
(Opoka et al., 2016)	Cerebral malaria	12.6	6 months	2.5	3.1	0.6		
	Severe malarial anemia	0.4		3.6	9.4	2.2		

* Indicates cumulative rates as of the last follow-up time

**Indicates specified mortality statistics in regards to percent of total post-discharges by a certain number of weeks, in relation to entire duration of follow-up

IPM, in-patient mortality; IP, in-patient; PDM, post-discharge mortality; PD, post-discharge.

Table 5: Risk Factors for PDM in All Admissions/Unspecified Infectious Admission Studies

Article	Risk Factor Category	Mortality Risk Factor upon Admission	Estimate Type	Estimate (95% CI)	Adjusted
All Admissions/ Unspecified Infectious Admissions					
(Veirum et al., 2007)	Age	Age at discharge ≥5 years (ref: age 1-12 months)	RR	**0.15 (0.07, 0.30)**	Yes
		Age at discharge 4 years (ref: age 1-12 months)	RR	**0.23 (0.10, 0.59)**	Yes
		Age at discharge 3 years (ref: age 1-12 months)	RR	**0.14 (0.06, 0.35)**	Yes
		Age at discharge 2 years (ref: age 1-12 months)	RR	**0.52 (0.33, 0.81)**	Yes
		Age at discharge 1 year (ref: age 1-12 months)	RR	0.82 (0.59, 1.13)	Yes
		Neonatal (ref: age 1-12 months)	RR	0.69 (0.31, 1.55)	Yes
	Diagnosis	Diagnosis: other --- includes chronic diseases which cannot be treated in Bissau (ref: malaria)	RR	**1.65 (1.08, 2.55)**	Yes
		Anaemia (ref: malaria)	RR	**1.97 (1.07, 3.63)**	Yes
		Diarrhea (ref: malaria)	RR	**1.82 (1.21, 2.74)**	Yes
		Bronchopneumonia (ref: malaria)	RR	0.98 (0.65, 1.51)	Yes
		Measles (ref: malaria)	RR	0.77 (0.36, 1.64)	Yes
	Hospital Stay	Leaving against medical advice	RR	**8.51 (5.32, 13.59)**	Yes
	Maternal Influence	Mother educated (ref: no maternal education)	RR	**0.74 (0.55, 0.99)**	Yes
(Moisi et al., 2011)	Age	Age 1–5m	HR	1.34 (0.93, 1.92)	Yes
		Age 6–11m	HR	0.82 (0.57, 1.18)	Yes
		Age 2–5y	HR	**0.57 (0.36, 0.90)**	Yes
		Sick young infant	HR	**2.67 (1.98, 3.58)**	Yes
	Diagnosis	Parasitemia	HR	**0.45 (0.29, 0.71)**	Yes
		Bacteraemia	HR	**1.77 (1.15, 2.74)**	Yes
		Mild pneumonia	HR	2.30 (1.00, 5.28)	Yes
		Severe pneumonia	HR	**1.37 (1.05, 1.79)**	Yes
		Very severe pneumonia	HR	**4.09 (2.25, 7.46)**	Yes
		Severe malnutrition	HR	**4.37 (2.73, 7.01)**	Yes
		Meningitis	HR	**2.29 (1.57, 3.32)**	Yes
	Growth Parameters	WAZ < −3	HR	**3.42 (2.50, 4.68)**	Yes
		WAZ < −4	HR	**6.53 (4.85, 8.80)**	Yes
	Hospital Stay	Hospitalization > 13 d	HR	**1.83 (1.33, 2.52)**	Yes
		1 prior discharge (occurring within 1 year of index discharge)	HR	**2.83 (2.04, 3.92)**	Yes
		2 prior discharges	HR	**7.06 (4.09, 12.21)**	Yes
		≥ 3 prior discharges	HR	**23.55 (10.70, 51.84)**	Yes
	Symptoms	Hypoxia	HR	**2.30 (1.64, 3.23)**	Yes
		Jaundice	HR	**1.77 (1.08, 2.91)**	Yes
		Hepatomegaly	HR	**2.34 (1.60, 3.24)**	Yes
(Wiens et al., 2015a)	Age	Age (months)	OR	**0.97 (0.97, 0.97)**	No
	Co-morbid Conditions	HIV positive	OR	**5.21 (2.55, 10.65)**	No

	Growth Parameters	MUAC (mm)	OR	**0.97 (0.96, 0.98)**	No
		Weight-for-age z score	OR	**0.66 (0.57, 0.76)**	No
		Weight for length/height z score	OR	**0.81 (0.72, 0.91)**	No
		Length/height-for-age z score	OR	**0.79 (0.70, 0.89)**	No
	Hospital Stay	Illness >7d prior to admission	OR	**0.50 (0.30, 0.83)**	No
		Time since last hospitalization (Ordered as <7 days, 7-30 days, 30 days to 1 year, >1 year and never (analysed as continuous and coded as 1–5, respectively)	OR	**0.75 (0.62, 0.90)**	No
	Labs/Assessments	Haemoglobin (g/dl)	OR	0.95 (0.87, 1.03)	No
		Blantyre coma scale <5 (ref: 5)	OR	**2.40 (1.27, 4.57)**	No
		Positive blood smear	OR	**0.33 (0.16, 0.68)**	No
	Maternal Influence	Maternal age (years)	OR	1.00 (0.97, 1.04)	No
		Maternal HIV positive (ref: HIV negative)	OR	1.79 (0.87, 3.67)	No
		Maternal HIV status unknown (ref: HIV negative)	OR	1.27 (0.64, 2.52)	No
		Maternal education primary 3-7 (ref: maternal education <P3)	OR	1.18 (0.62, 2.23)	No
		Maternal education some secondary (ref: maternal education <P3)	OR	0.72 (0.31, 1.70)	No
		Maternal education post-secondary (ref: maternal education <P3)	OR	1.18 (0.41, 3.36)	No
	Sex	Male	OR	0.90 (0.54, 1.51)	No
	Social Determinants of Health	Bed net use-- sometimes (ref: never)	OR	1.00 (0.48, 2.09)	No
		Bed net use-- always (ref: never)	OR	0.85 (0.46, 1.58)	No
		Siblings death	OR	1.54 (0.89, 2.65)	No
		Number of children in the family	OR	1.02 (0.92, 1.13)	No
		Boil all drinking water	OR	0.82 (0.47, 1.42)	No
		Distance from hospital 30-60min (ref: distance <30min)	OR	0.71 (0.31 1.64)	No
		Distance from hospital >60min (ref: distance <30min)	OR	1.30 (0.70, 2.41)	No
	Vital Signs	HR for age z score	OR	**0.86 (0.74, 0.99)**	No
		HR (raw)	OR	1.00 (0.99, 1.01)	No
		RR for age z score	OR	0.99 (0.92, 1.06)	No
		RR (raw)	OR	1.01 (1.00, 1.03)	No
		SBP z score	OR	0.94 (0.79, 1.12)	No
		SBP (raw)	OR	0.98 (0.96, 1.00)	No
		DBP (raw)	OR	0.99 (0.97, 1.01)	No
		Temperature (transformed)	OR	1.02 (0.90, 1.16)	No
		Temperature (raw)	OR	**0.76 (0.62, 0.93)**	No
		SpO2 (raw)	OR	**0.94 (0.92, 0.96)**	No
		SpO2 (transformed)	OR	**1.04 (1.02, 1.05)**	No

Table 6: Risk Factors for PDM in Malnutrition Studies

Article	Risk Factor Category	Mortality Risk Factor upon Admission	Estimate Type	Estimate (95% CI)	Adjusted
Malnutrition					
(Hennart et al., 1987)	**No Data**				
(Kerac et al., 2014)	Age	Age >60m (ref: age 48-60m)	HR	1.22 (0.63, 2.36)	Yes
		Age 36–48m (ref: age 48-60m)	HR	1.66 (0.84, 3.29)	Yes
		Age 24-36m (ref: age 48-60m)	HR	1.38 (0.76, 2.49)	Yes
		Age 12-24m (ref: age 48-60m)	HR	1.57 (0.89, 2.78)	Yes
		Age <12m (ref: age 48-60m)	HR	**2.49 (1.38, 4.51)**	Yes
	Co-morbid Conditions	HIV positive (ref: HIV negative)	HR	**4.03 (3.08, 5.25)**	Yes
		HIV unknown status (ref: HIV negative)	HR	**16.90 (12.10, 23.70)**	Yes
	Growth Parameters	Edema	HR	**0.58 (0.47, 0.72)**	Yes
		MUAC per cm unit increase	HR	**0.80 (0.74, 0.86)**	Yes
		Weight-for-height: per 1 unit z-score increase	HR	**0.75 (0.68, 0.83)**	Yes
		Weight-for-age: per 1 unit z-score increase	HR	**0.73 (0.66, 0.81)**	Yes
		Height-for-age: per 1 unit z-score increase	HR	**0.92 (0.86, 0.99)**	Yes
	Sex	Male	HR	0.89 (0.73, 1.08)	Yes
(Chisti et al., 2014)	Age	Age <12m	OR	2.05 (0.90, 4.90)	No
	Co-morbid Conditions	Confirmed TB	OR	1.74 (0.40, 6.90)	No
		Clinical TB – not confirmed	OR	0.15 (0.01, 1.10)	No
		History of previous pneumonia prior to present episode	OR	**3.4 (1.1, 10.2)**	No
	Growth Parameters	Severe wasting* (z score <-4 weight-for-height/length)	OR	**3.4 (1.5, 7.8)**	No
		Severe underweight* (z score <-5 weight-for-age)	OR	**3.05 (1.4, 6.8)**	No
		Severe wasting (z score <-4 weight-for-height/length)	OR	**2.74 (1.2, 6.2)**	No
		Severe underweight (z score <-5 weight-for-age)	OR	**2.82 (1.2, 6.7)**	No
		Nutritional edema	OR	2.34 (0.5, 9.6)	No
	Hospital Stay	Left against medical advice*	OR	**4.16 (1.5, 11.3)**	No
	Sex	Male	OR	0.68 (0.3, 1.5)	No
	Social Determinants of Health	Live outside Dhaka district	OR	1.69 (0.7, 4)	No
		Poor socio-economic condition - income <125 USD per month	OR	0.73 (0.3, 2)	No
	Symptoms	Lower chest wall in-drawing	OR	0.86 (0.4, 1.9)	No
		Hypoxemia (arterial oxygen saturation <90% in room air)	OR	1.23 (0.3, 4.7)	No
(Berkley et al., 2016)	Intervention	Co-trimoxazole versus placebo	HR	**0.90 (0.71-1.16)**	No
(Grenov et al., 2017)		**No Data**			

*Risk factor for mortality assessed upon discharge

Table 7: Risk Factors for PDM in Respiratory Infection Studies

Article	Risk Factor Category	Mortality Risk Factor upon Admission	Estimate Type	Estimate (95% CI)	Adjusted
Respiratory Infection					
(West et al., 1999)	**No Data**				
(Villamor et al., 2005)	Age	Age 6-11m (ref: ≥24m)	HR	**3.70 (1.72, 7.95)**	Yes
		Age 12-23m (ref: ≥24m)	HR	**3.14 (1.44, 6.88)**	Yes
	Co-morbid Conditions	HIV positive	HR	**3.92 (2.34, 6.55)**	Yes
	Diagnosis	Severe pneumonia on admission	HR	**2.47 (1.59, 3.85)**	Yes
	Growth Parameters	Stunted at baseline--- (2 z-scores (NCHS/WHO reference) in height-for-age. Wasted children were 2 z-scores in weight-for-height.)	HR	**2.12 (1.31, 3.42)**	Yes
		Low MUAC at baseline--- - (25th percentile of the population age-specific distribution)	HR	**1.88 (1.16, 3.03)**	Yes
	Labs/Assessments	Hemoglobin concentration ≤ 7.00 (g/dL) (ref: Hgb concentration >10 g/dl)	HR	**2.55 (1.13, 5.77)**	Yes
		Hemoglobin concentration 7.01–8.50 g/dl (ref: Hgb concentration >10 g/dl)	HR	**2.81 (1.24, 6.37)**	Yes
		Hemoglobin concentration 8.51–10.00 g/dl (ref: Hgb concentration >10 g/dl)	HR	1.76 (0.75, 4.10)	Yes
	Maternal Influence	Maternal education-elementary (ref: no maternal education)	HR	0.84 (0.48, 1.49)	Yes
		Maternal education-secondary or higher (ref: no maternal education)	HR	0.27 (0.06, 1.17)	Yes
		Mother works outside home	HR	0.61 (0.36, 1.03)	Yes
		Mother not living with partner	HR	1.60 (1.00, 2.57)	Yes
	Sex	Male	HR	0.98 (0.65, 1.48)	Yes
	Social Determinants of Health	Water tap in compound (ref: water tap in house)	HR	1.40 (0.60, 3.29)	Yes
		Water tap outside compound (ref: water tap in house)	HR	**2.27 (1.02, 5.03)**	Yes
		Public well (ref: water tap in house)	HR	**2.92 (1.03, 8.30)**	Yes
(Ashraf et al., 2012)	**No Data**				
(Reddy et al., 2014)	Intervention	Not receiving anti-TB medication (predictor of death within 2 weeks of admission)	OR	**0.25 (0.03, 2.00)**	No
		Not receiving anti-TB medication (predictor of death within 8 weeks of admission)	OR	**0.20 (0.04, 0.96)**	No
(Chhibber et al., 2015)	Age	Age (months)	HR	1.00 (0.98, 1.03)	Yes

	Co-morbid Conditions	Sepsis with Clinically Severe Malnutrition (CSM); (ref: pneumonia without CSM)	HR	**18.4 (11.3, 30.0)**	Yes
		Meningitis with CSM (ref: pneumonia without CSM)	HR	**13.7 (4.2, 44.7)**	Yes
		Pneumonia with CSM (ref: pneumonia without CSM)	HR	**8.1 (4.4, 14.8)**	Yes
		Meningitis without CSM (ref: pneumonia without CSM)	HR	**2.6 (1.2, 5.5)**	Yes
		Sepsis without CSM (ref: pneumonia without CSM)	HR	**2.2 (1.1, 4.3)**	Yes
	Growth Parameters	MUAC 11.5–13.0 cm (ref: MUAC >13cm)	HR	**7.19 (3.04, 17.01)**	Yes
		MUAC 10.5–11.4 cm (ref: MUAC >13cm)	HR	**24.2 (9.4, 61.9)**	Yes
		MUAC <10.5 cm (ref: MUAC >13cm)	HR	**43.7 (17.7, 108.0)**	Yes
	Hospital Stay	Non-medical discharge	HR	**4.68 (2.01, 10.85)**	Yes
	Labs/Assessments	Hemoglobin concentration (g/dL)	HR	**0.82 (0.73, 0.91)**	Yes
	Social Determinants of Health	Dry Season	HR	**1.96 (1.16, 3.32)**	Yes
	Symptoms	Neck Stiffness	HR	**10.4 (3.1, 34.8)**	Yes
	Vital Signs	Axillary temperature (degrees Celsius)	HR	**0.71 (0.58, 0.87)**	Yes
		SpO2 (%)	HR	**0.96 (0.93, 0.99)**	Yes
(Ngari et al., 2017)	Age	Age 12-23m (ref: age >24m)	HR	1.0 (0.1, 9.6)	Yes
		Age 6-11m (ref: age >24m)	HR	5.8 (0.8, 40.5)	Yes
		Age <6m (ref: age >24m)	HR	4.8 (0.7, 34.1)	Yes
	Co-morbid Conditions	Reported Preterm/Low Birth Weight	HR	0.7 (0.2, 2.8)	Yes
		HIV antibody test positive	HR	**6.5 (2.3, 18.4)**	Yes
		HIV test not performed	HR	0.4 (0.1, 3.6)	Yes
		RSV test positive	HR	0.3 (0.1, 1.2)	Yes
		RSV test not performed	HR	**2.7 (1.2, 6.3)**	Yes
		Malaria slide positive	HR	0.5 (0.1, 5.2)	Yes
		Bacteraemia	HR	0.8 (0.1, 5.2)	Yes
	Growth Parameters	MUAC per cm	HR	**0.6 (0.5, 0.8)**	Yes
	Hospital Stay	Duration of hospitalization (per day)	HR	1.1 (1.0, 1.2)	Yes
	Hospital Stay	Year of admission 2008 (ref: 2007 admission year)	HR	0.9 (0.3, 3.1)	Yes
		Year of admission 2009 (ref: 2007 admission year)	HR	0.5 (0.1, 2.1)	Yes
		Year of admission 2010 (ref: 2007 admission year)	HR	0.7 (0.2, 2.5)	Yes
		Year of admission 2011 (ref: 2007 admission year)	HR	1.7 (0.5, 5.3)	Yes
		Year of admission 2012 (ref: 2007 admission year)	HR	1.8 (0.2, 15.7)	Yes
	Labs/Assessments	Severe anaemia (Hgb <5 g/dL)	HR	0.8 (0.1, 7.5)	Yes
	Sex	Female	HR	0.5 (0.3, 1.1)	Yes

	Social Determinants of Health	Residence distance from hospital (per km)	HR	1.0 (0.9, 1.1)	Yes
	Symptoms	Capillary refill >2 s	HR	2.4 (0.5, 12.1)	Yes
		Impaired consciousness	HR	1.1 (0.2, 7.8)	Yes
		Wheezing	HR	0.5 (0.1, 2.4)	Yes
		Cough for >14 days	HR	0.2 (0.1, 5.5)	Yes
		Jaundice	HR	**12.5 (1.1, 13.7)**	Yes
	Vital Signs	Hypoxia (SaO2 <90%)	HR	1.9 (0.7, 5.4)	Yes
		Axillary temperature <36°C (ref: axillary temperature 36-39°C)	HR	0.3 (0.1, 2.8)	Yes
		Axillary temperature >39°C (ref: axillary temperature 36-39°C)	HR	1.1 (0.4, 3.0)	Yes
(Newberry et al., 2017)	Intervention	Prednisone (ref: placebo)	RR	**0.63 (0.41, 0.95)**	

Table 8: Risk Factors for PDM in Diarrhea Studies

Article	Risk Factor Category	Mortality Risk Factor upon Admission	Estimate Type	Estimate (95% CI)	Adjusted
	Diarrhea				
(Roy et al., 1983)	**No Data**				
(Stanton et al., 1986)	**No Data**				
(Islam et al., 1996)	Age	Age < 6 months	RR	**4.57 (2.90, 7.18)**	Yes
	Growth Parameters	Weight-for-age median <60%	RR	1.04 (0.57, 1.89)	Yes
		Length-for-age median <85%	RR	**2.97 (1.43, 6.16)**	Yes
	Maternal Influence	Mother's education (no school vs. ≥1 year)	RR	**2.12 (1.37, 3.28)**	Yes
		No breastfeeding	RR	**2.35 (1.44, 3.84)**	Yes
	Sex	Female	RR	**1.73 (1.14, 2.65)**	Yes
	Social Determinants of Health	Immunization not up-to-date	RR	**1.36 (1.25, 1.48)**	Yes

Table 9: Risk Factors for PDM in Anemia/Malaria Studies

Article	Risk Factor Category	Mortality Risk Factor upon Admission	Estimate Type	Estimate (95% CI)	Adjusted
Anemia/Malaria					
(Biai et al., 2007)	**No Data**				
(Phiri et al., 2008)	Age	Age (months)	HR	**0.92 (0.87, 0.97)**	Yes
	Co-morbid Conditions	HIV positive	HR	**10.49 (4.05, 27.20)**	Yes
		Bacteraemia	HR	2.17 (0.84, 5.64)	Yes
	Diagnosis	Malaria (Any parasite/mL blood)	HR	1.25 (0.67, 2.34)	No
	Growth Parameters	Wasting (<-2 Z-score Weight-for-height)	HR	0.74 (0.31, 1.80)	No
		Stunting (<-2 Z-score Height-for-age)	HR	0.61 (0.30, 1.22)	No
	Labs/Assessments	Iron deficiency (>5.6 sTfR/Log ferritin)	HR	0.91 (0.41, 2.03)	No
	Maternal Influence	Mother education (some)	HR	1.63 (0.72, 3.70)	No
	Sex	Male	HR	1.54 (0.68, 3.52)	Yes
	Social Determinants of Health	Rural residency	HR	1.63 (0.63, 4.20)	Yes
		Parents unemployed	HR	**4.15 (1.61, 10.74)**	Yes
	Symptoms	Splenomegaly	HR	**0.36 (0.16, 0.80)**	Yes
(Phiri et al., 2012)	**No Data**				
(Zucker et al., 1996)	Intervention	PS, quinine, TS treatment x5d (ref: chloroquine or no antimalarial)	RR	**0.33 (0.19, 0.65)**	Unspecified
	Labs/Assessments	Severe anaemia (Hgb <5 g/dL)	RR	**1.52 (1.22, 1.90)**	Unspecified
(Olupot-Olupot et al., 2014)	Intervention	30ml/kg transfusion versus 20ml/kg transfusion	RR	0.18 (0.02, 1.42)	Unspecified
(Opoka et al., 2016)	Diagnosis	Severe malarial anaemia*	HR	**16.26 (2.03, 130.34)**	Yes
		Cerebral malaria*	HR	4.45 (0.51, 38.55)	Yes

*Risk factor for readmission

Table 10: Respondent Demographics

Primary affiliations	**Number of Respondents (18)***
Teaching hospital	11
General/community hospital	2
Pediatric hospital	4
Outpatient clinic	1
University	9
Other	2 (research institute)
Roles at the institutions	
Physician	12
Nurse	2
Other clinician	0
Clinical scientist	6
Social scientist	0
Hospital administration	1
Epidemiologist	5
Other	0
Other areas of expertise	
Pediatrics	14
Infectious disease	6
Microbiology/laboratory medicine	0
Global health	9
Epidemiology	4
Social sciences	0
Neonatology	7
Obstetrics	2
Other areas identified: public health, pediatric pulmonology, critical care, internal medicine and surgery, informatics, implementation science, tropical oncology, immunology, emergency	
*Results based on respondent self-identification. Respondents were able to select all categories that applied; therefore, many identified more than one area.	

Table 11: Participant Perception of Post-Discharge Mortality Rates

	Post-Discharge Mortality Rates*			
	>10%	**5-10%**	**2-5%**	**<2%**
Children age 0-1 months	39%	50%	11%	0
Children age 1-12 months	17%	44%	39%	0

*within the first six months following discharge in children admitted with an infectious illness in resource-limited countries. Responses gathered pre-survey.

Table 12: Round 1 Surveyed Variables (N=37)

Clinical*	Birth	Laboratory*	Social/Demographic
1. Temperature 2. Respiratory rate 3. Oxygen saturation (SpO2) 4. Age 5. Dehydration (using WHO dehydration scale) 6. Central cyanosis 7. Anthropometrics (weight, height, MUAC) 8. Chest indrawing 9. Bulging fontanel 10. Feeding status 11. Jaundice 12. Multiple associated infectious symptoms (e.g. pneumonia + diarrhea/sepsis/UTI) 13. Grunting 14. Diarrhea 15. Convulsions 16. Abdominal distension 17. Hepatomegaly 18. Capillary refill 19. Coma score (i.e. Blantyre Coma Scale) 20. Other comorbidities (e.g. congenital defect, sickle cell anemia, TB etc.)	1. Birth weight 2. Location of birth (home vs facility) 3. Use of maternal antenatal care 4. Number of weeks gestation at birth 5. Mother's age at time of birth of first child	1. Blood glucose 2. Blood culture 3. Blood lactate level 4. HIV status	1. Sex 2. Number of siblings 3. Exclusively breastfed for first 5 months 4. Mother's education (# of years) 5. Immunization status 6. Number of previous hospitalizations 7. Distance from child's home to nearest health facility 8. Mother's age

* at time of admission

Table 13: Proposed Additional Variables and Subsequently Surveyed Variables in Round 2

Category	**Proposed Additional Variables (N=26)**	**Round 2 Surveyed Variable (N=27)**
Clinical Variables	Weight gain/history of weight loss	History of weight gain/weight loss
	Pallor/anemia (marker of malnutrition/chronic illness)	Pallor at time of admission
	Oral/motor coordination/impairment (predisposing to malnutrition/dehydration/aspiration)	Oral/motor coordination impairment
	Malnutrition	*Not included as a new variable to survey, as it is evaluated under previous variables "anthropometrics, feeding status, and abdominal distention"*
	Specific comorbidities	*Not included as a new variable to survey, as it is evaluated under previous variable "other comorbidities"*
	Hypotonia/spasticity (restrictive lung disease/aspiration/poor nutrition)	Hypotonia at time of admission
		Spasticity at time of admission
	Blood in stool (dysentery)	Blood in stool (dysentery)
	Cough of two or more weeks	History of cough for two or more weeks
	Length of illness prior to admission/long duration of illness	Duration of present illness at time of admission
Birth Variables	Perinatal infection	History of perinatal infection (except HIV)
	Birth asphyxia	History of birth asphyxia
	Mode of delivery and color of baby at birth	Mode of delivery (vaginal vs. caesarean section)
		Skin color at birth to detect hypoxemia, anemia, infection, stress etc.
	Any resuscitation/treatment needed immediately after delivery	History of resuscitation after delivery
	Umbilical cord practices (risk of tetanus and sepsis)	Details of umbilical cord care at/after birth (e.g. cutting, cleaning practices, cultural practices, etc.)
Laboratory Variables	Hemoglobin	Hemoglobin at time of admission
	Platelets	Platelet count at time of

		admission
	Urea/creatinine	Urea/creatinine at time of admission
	White cell count	White blood cell count at time of admission
	Sickle cell/thalassemia status	Sickle cell/thalassemia status
Social/ demographic Variables	Deceased or sick mother	Mother is acutely ill (at time of admission)
		Mother is chronically ill (HIV, TB, mental illness, etc.)
		Mother has died
	Resources/salaries/health insurance	Family wealth index
		Child is covered under a health insurance plan
	Maternal immunization status (such as tetanus)	*Already captured by maternal chronic and acute illness, and child's comorbidities*
	Exclusive BF vs BF + supplementation vs supplementation as well as type of supplementation (cow milk vs formula)	*Not included as a new variable to survey, as it is evaluated under previous variable "exclusively breasted for first 5 months"*
	Caregiver other than mother (e.g. father, grandmother, aunt)	Primary caregiver (at home) other than mother (e.g. father, grandmother, aunt)
		Primary caregiver (during admission) other than mother (e.g. father, grandmother, aunt)
	Mode of transport	Mode of transport to health facility (e.g. by foot, public transport, private car)
	Smoking/drinking (behavioral factors)	Parental substance use (e.g. smoking, alcohol consumption)

Table 14: Final list of candidate predictor variables (N=55)

Clinical*	Birth	Laboratory*	Social/Demographic
1. Temperature 2. Respiratory rate 3. Oxygen saturation (SpO2) 4. Age 5. Dehydration (using WHO dehydration scale) 6. Anthropometrics (weight, height, MUAC) 7. Chest indrawing 8. Bulging fontanel 9. Feeding status 10. Jaundice 11. Multiple associated infectious symptoms (e.g. pneumonia + diarrhea/sepsis/UTI) 12. Grunting 13. Diarrhea 14. Convulsions 15. Abdominal distension 16. Capillary refill 17. Coma score (i.e. Blantyre Coma Scale) 18. Other comorbidities (e.g. congenital defect, sickle cell anemia, TB etc.) 19. History of weight gain/weight loss 20. Pallor 21. Oral/motor coordination impairment 22. Hypotonia 23. Spasticity	1. Birth weight 2. Location of birth (home vs facility) 3. Use of maternal antenatal care 4. Number of weeks gestation at birth 5. Mother's age at time of birth of first child 6. History of birth asphyxia 7. Mode of delivery (vaginal vs caesarean section) 8. History of resuscitation after delivery 9. Details of umbilical cord care at/after birth (ex: cutting, cleaning practices, cultural practices, etc.)	1. Blood glucose 2. Blood lactate level 3. HIV status 4. Hemoglobin 5. Sickle cell/thalassemia status	1. Sex 2. Number of siblings 3. Exclusively breastfed for first 5 months 4. Mother's education (# of years) 5. Immunization status 6. Number of previous hospitalizations 7. Distance from child's home to nearest health facility 8. Mother's age 9. Mother is acutely ill (at time of admission) 10. Mother is chronically ill (HIV, TB, mental illness, etc.) 11. Mother has died 12. Primary caregiver (at home) other than mother (e.g. father, grandmother, aunt) 13. Primary caregiver (during admission) other than mother (e.g. father,

24. Blood in stool (dysentery) 25. History of cough for two or more weeks 26. Duration of present illness			grandmother, aunt) 14. Mode of transport to health facility (e.g. by foot, public transport, private car) 15. Parental substance use (e.g. smoking, alcohol consumption)

*at time of admission

Figure 1: Prisma Diagram

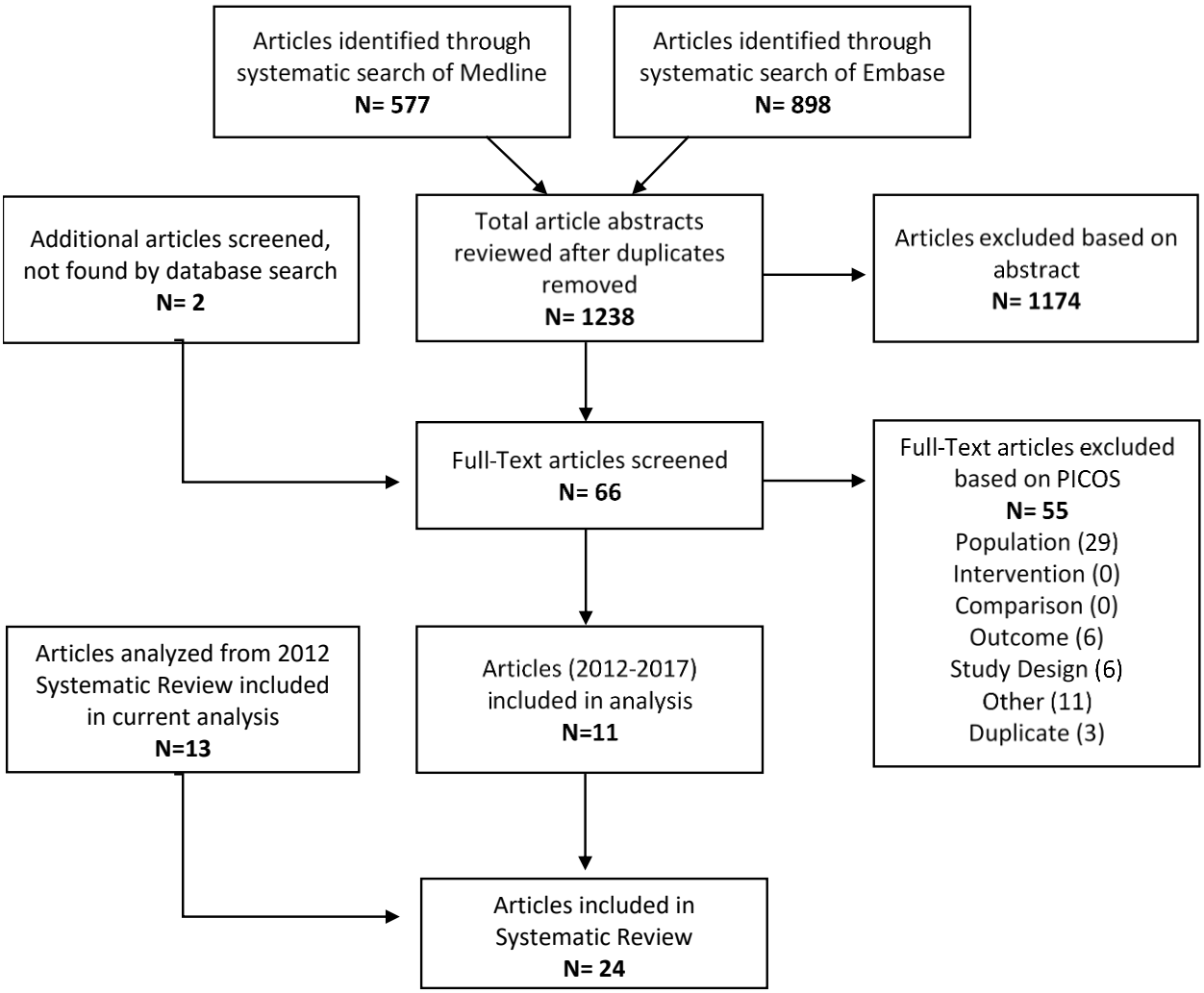
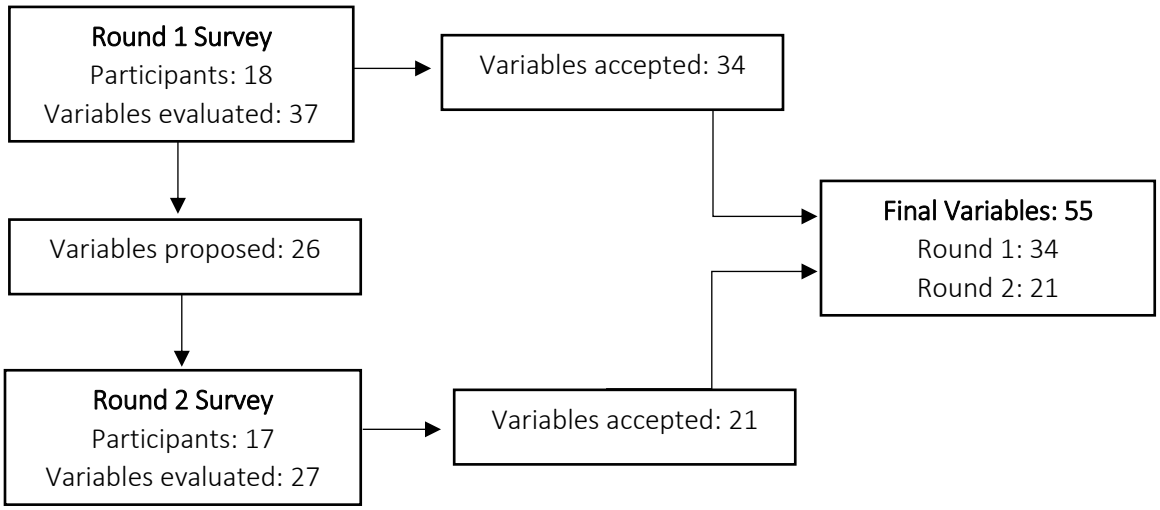


Figure 2: Flow Diagram of Delphi Process



Appendix 1: Literature Search Strategies

Table 1a: Search Strategy for MEDLINE (July 18, 2017)

No.	Search Category	Terms	Hits
1	Post-Discharge Mortality	Exp Follow-Up Studies/ or exp Hospitalization/ or exp Longitudinal Studies/ or (postadjdischarge or after discharge or longadjterm outcome* or longadjterm followadjup or longadjterm mortality or followadjup stud*).ti,ab.	880860
2		exp Mortality/ or (mortality or postadjdischarge mortality or postadjdischarge death or postadjdischarge fatal* or postadjhospital*adjmortality or postadjhospital* fatal* or postadjhospital* death or longadjterm mortality or postadjhospital mortality).ti,ab.	770469
3		1 and 2	128056
4	Developing Countries	exp Africa/ or exp Haiti/ or exp Afghanistan/ or exp Yemen/ or exp Melanesia/ or exp Syria/ or exp Developing Countries/ or (Africa* or Haiti or Afghanistan or Yemen or Melanesia or Solomon Island* or Papua New Guinea or Syria*).ti,ab.	401121
5		(lowadjresource countr* or resource poor countr* or developing countr*).ti,ab.	44097
6		exp Bangladesh/ or exp Myanmar/ or exp Pakistan/ or (Bangladesh or Myanmar or Burma or Pakistan).ti,ab.	30050
7		4 or 5 or 6	445820
8	Combining Categories	3 and 7	4093
9	Exclusions	((comment or editorial or meta-analysis or practice-guideline or review or letter or journal correspondence or posters or News or Newspaper article or meeting abstracts or lectures or interview or historical article or handbooks or guidelines or guidebooks or essays or editorial or database or comment or clinical conference or catalogs) not "randomized controlled trial").pt.	4255011
10		Animals/	6167864
11		8 not (9 or 10)	3836
12	Limiting	limit 11 to ("infant (1 to 23 months)" or "preschool child (2 to 5 years)" or "child (6 to 12 years)")	1710
13		limit 12 to yr="2012 -Current"	601
14		**limit 13 to English**	**577**

Table 1b: Search Strategy for Embase (July 18, 2017)

No.	Search Category	Terms	Hits
1	Post-Discharge Mortality	exp follow up/ or exp hospitalization/ or exp longitudinal study/ or (postadjdischarge or after discharge or longadjterm outcome* or longadjterm followadjup or longadjterm mortality or followadjup stud*).ti,ab	1516787
2		exp mortality rate/ or exp mortality/ or exp mortality risk/ or exp childhood mortality/ or exp childhood death/ or (mortality or postadjdischarge mortality or postadjdischarge death or postadjdischarge fatal* or postadjhospital*adjmortality or postadjhospital* fatal* or postadjhospital* death or longadjterm mortality or postadjhospital mortality).ti,ab.	1193617
3		1 and 2	220868
4	Developing Countries	exp Africa/ or exp Haiti/ or exp Afghanistan/ or exp Yemen/ or exp Solomon Islands/ or exp Syrian Arab Republic/ or exp Papua New Guinea/ or (Africa* or Haiti or Afghanistan or Yemen or Melanesia or Solomon Island* or Papua New Guinea or Syria*).ti,ab.	440592
5		exp developing country/ or (lowadjresource countr* or resourceadjpoor countr* or developing countr*).ti,ab.	120202
6		exp Bangladesh/ or exp Myanmar/ or exp Pakistan/ or (Bangladesh or Myanmar or Burma or Pakistan).ti,ab.	42892
7		4 or 5 or 6	568957
8	Combining Categories	3 and 7	7569
9	Exclusions	((comment or editorial or meta-analysis or practice-guideline or review or letter or journal correspondence or posters or News or Newspaper article or meeting abstracts or lectures or interview or historical article or handbooks or guidelines or guidebooks or essays or editorial or database or comment or clinical conference or catalogs) not "randomized controlled trial").pt.	3811629
10		Animals/	1649863
11		8 not (9 or 10)	7019
12	Limiting	limit 11 to (infant <to one year> or child <unspecified age> or preschool child <1 to 6 years> or school child <7 to 12 years>)	1804
13		limit 12 to yr="2012 -Current"	909
14		**limit 13 to English**	**898**

Appendix 2: Studies Excluded at Full-Text

Study Identification	Study Title	Exclusion Reason
Abossie et al., 2017	Assessment of isoniazid preventive therapy in the reduction of tuberculosis among art patients in Arba Minch Hospital, Ethiopia	Population
Agarwal et al., 2013	A randomized trial of artemether-lumefantrine and dihydroartemisinin- piperaquine in the treatment of uncomplicated malaria among children in western Kenya	Population
Ali et al., 2013	Is mid-upper arm circumference alone sufficient for deciding admission to a nutritional programme for childhood severe acute malnutrition in Bangladesh?	Population
Ashraf et al., 2012	Observational follow-up study following two cohorts of children with severe pneumonia after discharge from day care clinic/hospital in Dhaka, Bangladesh	Duplicate
Ashraf et al., 2012	A follow-up experience of 6 months after treatment of children with severe acute malnutrition in Dhaka, Bangladesh	Population
Bisanzo et al., 2015	Characterization of emergency presentations at regional referral hospital in a low-income country	Other
Bower et al., 2016	Deaths, late deaths, and role of infecting dose in Ebola virus disease in Sierra Leone: retrospective cohort study	Population
Brand et al., 2012	Clinical predictors of hospital readmission in Ugandan children with cerebral malaria	Other
Chang et al., 2013	Children successfully treated for moderate acute malnutrition remain at risk for malnutrition and death in the subsequent year after recovery	Population
Chiabi et al., 2012	The frequency and magnitude of growth failure in a group of HIV-infected children in Cameroon	Population
Chisti et al., 2014	Post-discharge mortality in children with severe malnutrition and pneumonia in Bangladesh	Duplicate
Dwyer et al., 2014	Reducing maternal and child mortality rates in Pakistan	Study Design
Ebissa et al., 2015	Predictors of early mortality in a cohort of HIV-infected children receiving high active antiretroviral treatment in public hospitals in Ethiopia	Population
English et al., 2016	Pediatric out-of-hospital deaths following hospital discharge: A mixed-methods study	Outcome
Fitzgerald et al., 2016	Ebola virus disease in children in Sierra Leone: A retrospective cohort study	Study Design
Fitzgerald et al., 2016	Comparison of children testing negative and positive for Ebola virus disease in Ebola holding units, Sierra Leone	Study Design
Flick et al., 2016	Burden of disease and risk factors for death among children treated for tuberculosis in Malawi	Population

Freemark et al., 2015	Metabolomics in nutrition research: biomarkers predicting mortality in children with severe acute malnutrition	Outcome
George et al., 2013	The systemic inflammatory response syndrome as a predictor of mortality among febrile children in the emergency department	Other
Girum et al., 2017	Survival status and predictors of mortality among severely acute malnourished children <5 years of age admitted to stabilization centers in Gedeo Zone: A retrospective cohort study	Outcome
Gwer et al., 2013	Fosphenytoin for seizure prevention in childhood coma in Africa: A randomized clinical trial	Outcome
Heikens et al., 2017	African Children with Severe Pneumonia Remain at High Risk for Death Even After Discharge	Study Design
Henderson et al., 2013	Antibiotics cut death rates in children with malnutrition	Other
Hladik et al., 2012	Association between transfusion with human herpesvirus 8 antibody-positive blood and subsequent mortality	Population
Homaira et al., 2012	Influenza-associated mortality in 2009 in four sentinel sites in Bangladesh	Outcome
Khan et al., 2014	Readmission to paediatric intensive care unit: Frequency, causes and outcome	Population
Kotloff et al., 2013	Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): A prospective, case-control study	Population
Koye et al., 2012	Predictors of mortality among children on Antiretroviral Therapy at a referral hospital, Northwest Ethiopia: A retrospective follow up study	Population
Kyeyune et al., 2014	The interaction between malaria and human immunodeficiency virus infection in severely anaemic Malawian children: A prospective longitudinal study	Other
Mibei et al., 2016	Treatment outcomes of drug-resistant tuberculosis patients in Kenya	Population
Mohamed et al., 2017	Efficacies of DHA-PPQ and AS/SP in patients with uncomplicated Plasmodium falciparum malaria in an area of an unstable seasonal transmission in Sudan	Population
Mord et al., 2013	NECT feld phase IIIb trial: Final effectiveness in adults and children results	Study Design
Moschovis et al., 2014	Stunting predicts poor outcome in children with severe pneumonia	Population
Mwanga-Amumpaire et al., 2012	Effect of vitamin A adjunct therapy for cerebral malaria in children admitted to Mulago hospital: a randomized controlled trial	Population
Njuguna et al., 2016	Urgent versus post-stabilization art in hospitalized children: A randomized trial	Study Design

Oluwayemi et al., 2013	Neurological sequelae in survivors of cerebral malaria	Population
Opoka et al., 2012	Risk of readmission or death within six months after initial discharge among Ugandan children with severe malarial anemia and cerebral malaria	Other
Ouma et al., 2012	Functional haplotypes of Fc gamma (Fcgamma) receptor (FcgammaRIIA and FcgammaRIIIB) predict risk to repeated episodes of severe malarial anemia and mortality in Kenyan children	Population
Patel et al., 2012	Risk factors for predicting diarrheal duration and morbidity in children with acute diarrhea	Population
Phiri et al., 2012	Intermittent preventive therapy post-discharge (IPTpd) to prevent rebound severe malaria anaemia in young children	Other
Poirot et al., 2016	Development of a pharmacovigilance safety monitoring tool for the rollout of single low-dose primaquine and artemether-lumefantrine to treat Plasmodium falciparum infections in Swaziland: A pilot study	Population
Qamar et al., 2016	Predictors of diarrheal mortality and patterns of caregiver health seeking behavior in in Karachi, Pakistan	Population
Rainwater-Lovett et al., 2013	Immunologic risk factors for early mortality after starting antiretroviral therapy in HIV-Infected Zambian children	Population
Rodriguez-Barraquer et al., 2016	Quantifying Heterogeneous Malaria Exposure and Clinical Protection in a Cohort of Ugandan Children	Population
Rolling et al., 2012	Extended haematological follow-up after parenteral artesunate in African children with severe malaria	Other
Shabani et al., 2013	High levels of erythropoietin are not associated with neuroprotection in Ugandan children with cerebral malaria	Population
Somasse et al., 2016	Relapses from acute malnutrition and related factors in a community-based management programme in Burkina Faso	Population
Soni et al., 2017	Clinical profile and neurodevelopmental outcome of new-onset acute symptomatic seizures in children	Population
Sreenivasan et al., 2012	Sequelae of moderate-to-severe diarrhea among young children in Western Kenya, 2008-2011	Other
Tiemeier et al., 2013	The effect of geography and demography on outcomes of emergency department patients in rural Uganda	Other
Phiri et al., 2012	Intermittent preventive therapy for malaria with monthly artemether-lumefantrine for the post-discharge management of severe anaemia in children aged 4-59 months in southern Malawi: a multicentre, randomised, placebo-controlled trial	Duplicate
van den Boogaard et al., 2017	How do low-birthweight neonates fare 2 years after discharge from a low-technology neonatal care unit in a rural district hospital in Burundi?	Population
van Dijk et al., 2013	Effectiveness of Efavirenz-Based Regimens in Young HIV-Infected Children Treated for Tuberculosis: A Treatment	Population

	Option for Resource-Limited Settings	
Wirth et al., 2012	Immunologic effects of measles infection among hivpositive children and adolescents in Botswana	Other
Zubairi et al., 2017	Hyaluronidase-Assisted Resuscitation in Kenya for Severely Dehydrated Children	Outcome