

# **Intervention Proposal for the Prevention of Sudden Unexpected Infant Death (SUDI) in South Africa**

by

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**Abstract**

Infant mortality, the death of a child under age one, is an important global public health issue. Although progress has been made, many countries still experience high levels of infant death. In South Africa, significant poverty and inequality have led to one of the highest rates of sudden unexpected infant death in the world. A literature search was conducted to identify published literature about programs, policies, and interventions that aim to decrease sudden infant death. The results of the literature review were used to propose a plan for reducing infant deaths in South Africa. The proposed plan includes an infant death investigation protocol, healthcare provider and parental education, an infant screening system, bassinet distribution, and a public health campaign. The proposed plan is designed to reach the families most in need of support and resources to keep infants safe.

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## 1.0 Introduction

Infant mortality, the death of a child under age one, has affected humans throughout history. Modern medical practices and increased sanitation have significantly reduced the number of infants dying; annual infant deaths have declined from 8.8 million in 1990 to 4.1 million in 2017 (World Health Organization [WHO], 2019). However, infant mortality continues to affect children globally. In 2018 more than 2.5 million children died in the first *month* of life (WHO, 2019). Sudden Unexpected Infant Death (SUID), a specific type of infant mortality, is not readily understood and continues to contribute to high numbers of infant death in many countries. South Africa is one of the countries that struggles with high sudden infant death rates.

South Africa transitioned to a democratic government in the mid-1990s and has made considerable strides towards improving the wellbeing of its citizens (The World Bank, 2019b). However, progress has been slow. High inequality is exacerbated by a legacy of exclusion and economic growth that does not benefit the poor. The country lags behind many other middle income countries in terms of equality between citizens (The World Bank, 2019b). These factors have contributed to high rates of sudden unexpected infant death in South Africa.

This thesis explores the factors contributing to sudden infant death in South Africa, presents a literature review of published sudden infant death reduction programs and interventions, and proposes a plan for reducing sudden infant death in South Africa. The background outlines global infant mortality and the improvements that have been made in the last several decades. It examines the risk factors and recommendations for sudden infant death, as well as South Africa's healthcare history, disparities, infant mortality rates, and current reduction efforts. The methods section presents the details of the literature search, and the results section details study selection

and characteristics. The discussion offers an analysis of articles and proposes a plan for reducing sudden infant death rates in South Africa, consisting of the implementation of a sudden infant death investigation protocol, healthcare provider and parental education, an infant screening system, home visits with bassinet distribution, and a public health campaign. The conclusion addresses limitations, opportunities for further research, and advocacy.

## **2.0 Background**

### **2.1 Infant Mortality**

Infant mortality is the death of an infant before his or her first birthday and is an important indicator of the overall health of a society. The infant mortality rate is reported as the number of infant deaths for every 1,000 live births (United States Department of Health and Human Services [U.S. DHHS], 2019). The majority of neonatal deaths occur in the first week of an infant's life, making the first 24 hours after birth a crucial period for survival. Preterm birth, intrapartum-related complications such as birth asphyxia, infections, and birth defects are the leading cause of death in the first month of life (WHO, 2019). Additionally, when infants are undernourished, malnutrition becomes a contributing factor and makes them more vulnerable to disease.

#### **2.1.1 Global Infant Mortality**

The number of global infant deaths declined from 65 deaths per 1,000 live births in 1990 to 29 deaths per 1,000 live births in 2017 (WHO, 2020). Although all infants are vulnerable in some respect, there are regional and country effects determining which infants have survival advantages over others. Disparities in infant mortality between regions and income levels are as extreme as the disparities between countries. Afghanistan's infant mortality rate is 48 deaths per 1,000 live births, while the United States and the United Kingdom have rates of six deaths and four deaths per 1,000 live births, respectively (The World Bank, 2019a). The 2017 infant mortality rate was three deaths per 1,000 live births in the European Union, 53 deaths per 1,000 live births

in Sub-Saharan Africa, four deaths per 1,000 live births in high income countries, and 48 deaths per 1,000 live births in low income countries (The World Bank, 2019a). The rate among Organization for Economic Cooperation and Development member countries' was five deaths per 1,000 live births, while the rate for fragile and conflict affected countries was 51 deaths per 1,000 live births.<sup>1</sup> An infant born in the African Region has a six times higher likelihood of dying in their first year of life than an infant born in Europe (WHO, 2019).

### **2.1.2 Improvements in Infant Mortality**

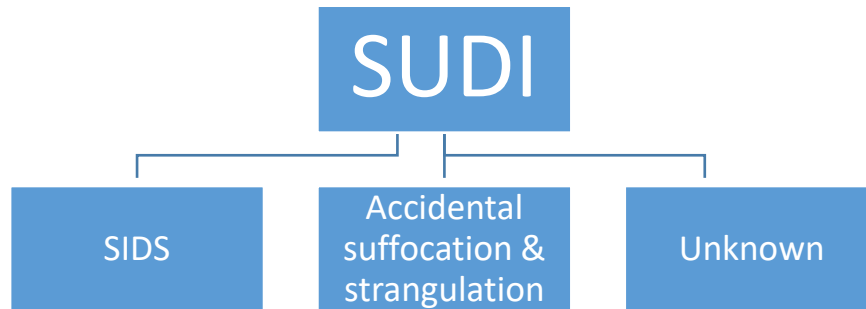
There has been significant global progress in infant mortality over the last several decades. The neonatal mortality rate, the number of deaths within the first 28 days of life, has declined from 31 deaths per 1,000 live births in 2000 to 18 deaths per 1,000 live births in 2017 (U.N., 2019a). In 2015 the United Nations Member States adopted the Sustainable Development Goals, a 15-year plan to end poverty and improve the lives of global citizens (U.N., 2019b). Sustainable Development Goal 3, Good Health and Well-Being, calls for ending preventable deaths of newborns and children under five years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 deaths per 1,000 live births by 2030 (U.N., 2019a). Of the 238 countries for which infant mortality data are available, 92 of them had infant mortality rates at or below 12 deaths per 1,000 live births as of 2018 (The World Bank, 2019a). The global community has recognized that reducing infant mortality is an important aspect of improving global health, but additional efforts are necessary to bring infant mortality down to the target level.

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<sup>1</sup> Fragile and conflict affected countries experience cycles of high levels of violence, high rates of poverty, displacement of populations, spread of disease, reduced trade, and increased crime and terrorism.

## 2.2 SUDI and SIDS

Sudden unexpected death in infants (SUDI or SUID), a type of infant mortality, is the sudden and unexpected death of a baby less than one year old in which the cause of death was not obvious *before* an investigation (Centers for Disease Control and Prevention [CDC], 2018a). These deaths often happen during sleep or in the baby’s sleep area. Sudden Infant Death Syndrome (SIDS), a type of SUDI, is the sudden unexpected death of a baby less than one year old that does not have a known cause even *after* a complete investigation involving an autopsy, death scene investigation, and review of clinical history (CDC, 2018a). About half of SUDI cases are classified as SIDS (U.S. DHHS, 2020c). Other causes of SUDI include accidental suffocation and strangulation in bed and unknown causes (CDC, 2019) (Figure 1).



**Figure 1. The Relationship Between Types of Unexpected Infant Death**

The final diagnosis assigned depends upon the findings of the death scene investigation and autopsy. These types of death are certified differently in various countries, making comparisons of SUDI rates across countries difficult (Taylor et al., 2015). Diagnostic criteria and death certification processes have changed over time, resulting in large variations in how each country codes a SUDI death. Additionally, there are no reliable pathological markers for suffocation and it is often difficult to conclusively determine that a death was due to asphyxia, particularly when no one was present at the time of death (Taylor et al., 2015). There are differences in ICD-10 coding practices for SUDI across and within countries, further hindering the public health community's ability to follow trends in these deaths (Taylor et al., 2015). Although there may be discrepancies when it comes to classifying infant deaths, all deaths of infants under the age of one are, and should be, included in infant mortality reporting and statistics.

### **2.3 Risk Factors and Recommendations for SUDI**

It is often difficult to determine the cause of death in situations when infants cease to breathe in their sleep, especially when no one is present, and rates for both SUDI and SIDS are confounded by cases where the death may be due to other causes. Researchers are still uncertain of the specific epidemiological causes of SIDS, and until the causes are found or a diagnostic test is available, investigators cannot be certain which infant deaths are due to 'true' SIDS or SUDI (Pelligra, Doman, & Leisman, 2005). Although the clinical epidemiology is not yet clear, there are well-known risk factors for infant death, most of which involve an infant's sleep environment (U.S. DHHS, 2020c). The following are established risk factors:

- Sleeping on stomach;

- Sleeping on soft surface;
- Sleeping on/under soft or loose bedding;
- Getting too hot during sleep;
- Preterm birth or low birth weight;
- Being two-three months of age;
- Being exposed to cigarette smoke in the womb or in the environment; and
- Sleeping in bed with a parent, children, or pet, especially if the adult smokes, has recently had alcohol, or is tired; the baby is covered with a blanket; the baby is sleeping with more than one bed-sharer; the baby is younger than 11 to 14 weeks of age (U.S. DHHS, 2020c).

In addition to these well-known risk factors, others have been explored and studied. In a German study, the bacterium *B. pertussis*, which causes pertussis, was present in 5% of infants whose cause of death was SIDS or respiratory infections (Heininger, Kleemann, Cherry, & Sudden Infant Death Syndrome Study, 2004). *B. pertussis* infections in infancy are associated with apneic spells, which may be reported as SIDS if the apneic spell becomes life-threatening and leads to death (Heininger et al., 2004). Low or no maternal professional education has also been listed as a risk factor (Schellscheidt, Ott, & Jorch, 1997). In recent years there has been a focus on designated high-risk populations. Ethnic minorities (Tipene-Leach & Abel, 2019), parents with low socio-economic status (SES) (Geib, Aerts, & Nunes, 2006), and African Americans in the United States (Stiffler, Ayres, Fauvergue, & Cullen, 2018) all have documented increased risks of infant vulnerability to unexpected death.



In response to the established risk factors, the American Academy of Pediatrics (AAP) makes the following recommendations for creating safe sleep environments for infants and reducing the risk of sleep-related deaths:

- Supine sleep positioning<sup>2</sup>;
- Use of a firm sleep surface;
- Room sharing without bedsharing;
- Avoidance of soft bedding and overheating;
- Avoidance of exposure to smoke, alcohol, illicit drugs;
- Breastfeeding;
- Routine immunization; and
- Use of a pacifier (AAP, 2016).

In addition to these recommendations, other evidence-based recommendations have been made on smaller scales. New Zealand researchers found a lower SIDS risk amongst infants who were firmly tucked in and slept on top of a waterproof wool under-blanket (Wilson, Taylor, Laing, Williams, & Mitchell, 1994), and U.S. researchers found reduced incidence of SIDS with the use of a fan in the infant sleeping environment (Coleman-Phox, Odouli, & Li, 2008). Further, there is evidence to suggest that health department messaging plays a larger role in supine sleep positioning than private physicians (Lahr, Rosenberg, & Lapidus, 2005). As noted above, infants in the African Region have a higher likelihood of dying in their first year of life. In the next

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<sup>2</sup> The supine position means lying horizontally with the face and torso facing up, as opposed to the prone position, which is face down.

section, information about South Africa's infant death prevalence and prevention efforts will be explored.

## **2.4 South Africa**

### **2.4.1 South Africa's Healthcare History**

The union of South Africa was created in 1910, and an apartheid regime quickly came to power. In 1948 the pro-Afrikaner National Party developed an authoritarian approach to segregation (South African Government, 2019). Many of the policies created and enforced during South Africa's apartheid era were unequal and resulted in racial disparities. As a result, South Africa's healthcare sector was segregated during the apartheid era, and the policies that existed during that time focused on improving the lives for the minority white population (Ataguba & Alaba, 2012). Health services for the majority black population and people in rural areas were neglected and underfunded. These policies have exacerbated income inequality, weakened government commitment to healthcare, and contributed to increased health inequities (Ataguba & Alaba, 2012).

In 1994 the South African government ended apartheid and subsequently eliminated racist legislation and policy. In the following decades, advances in South Africa included economic growth, an expansion of the Black African middle class, and an increased number of social grants to poor and unemployed citizens (Mayosi & Benatar, 2014). Although considerable progress has been made in reversing discriminatory practices, the poor continue to suffer more than the rich due to inequities (Mayosi & Benatar, 2014). Though exact numbers vary, sources agree that South

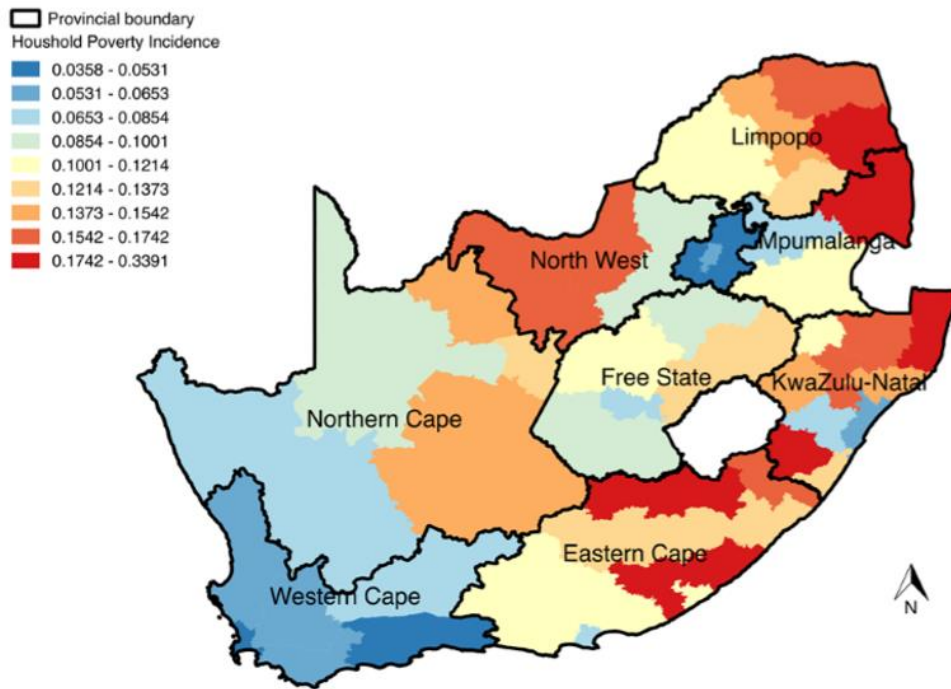
Africa is one of the most unequal countries in the world, with a GINI coefficient of approximately 0.62 (Organisation for Economic Co-operation and Development, 2018).<sup>3</sup> It is estimated that the top 1% of South Africans own nearly 71% of the nation's wealth while the bottom 60% own only 7% of the nation's wealth (Beaubien, 2018). The legacy of apartheid spatial planning is still evident in the geographical distribution of poverty and inequality in South Africa (Statistics South Africa, 2018).

#### **2.4.2 Disparities in South Africa**

In 2015, 13.8 million South Africans were living below the food poverty line, affecting 25.2% of individuals and 12% of households (Statistics South Africa, 2018). Disparities in poverty and access to resources exist across provinces and between urban and rural areas. Figure 2 displays household poverty incidence at the district level (Statistics South Africa, 2018). In 2015, 59.7% of the poor lived in rural areas (International Bank for Reconstruction and Development, 2018).

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<sup>3</sup> The GINI coefficient is a measure of inequality based on the comparison of cumulative proportions of the population against cumulative proportions of the income they receive. The coefficient ranges from 0 to 1; 0 represents perfect equality and 1 represents perfect inequality.



**Figure 2. 2011 Household Poverty Incidence at the District Level**  
 (Statistics South Africa, 2018)

In 2015, 93% of South Africa’s population had access to an improved water source, 66% had access to improved sanitation facilities, and in 2014 87% had access to electricity (International Bank for Reconstruction and Development, 2018). However, access is not equal amongst all South African citizens. There is a difference of 20 percentage points in electricity access between the richest and poorest decile and a difference of 43 percentage points in access to an improved water source (International Bank for Reconstruction and Development, 2018).

Similar disparities are present in housing conditions and access to healthcare. In 2015, 39% of the population was considered to be living in overcrowded conditions; the proportion among the poor is 60.8% (International Bank for Reconstruction and Development, 2018). Similarly, the poor live farther away from hospitals than the non-poor. Amongst individuals in

the poorest decile, 33.8% live at least 20 kilometers (12.4 miles) from a hospital, 27 percentage points higher than the proportion among the richest decile (International Bank for Reconstruction and Development, 2018).

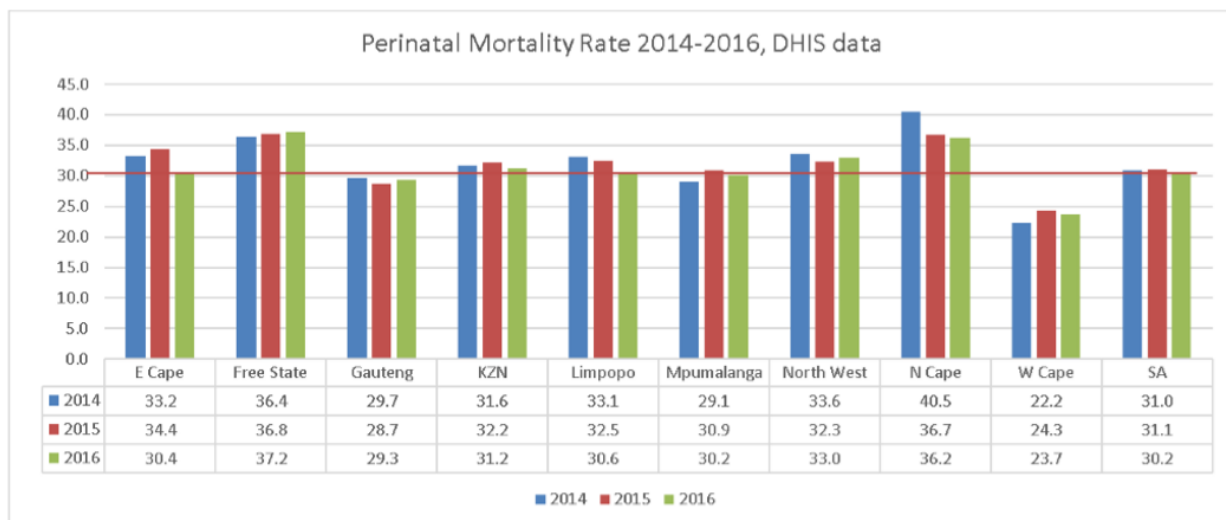
South Africa's history has led to a higher concentration of poverty among certain groups compared to others. Poverty is higher among those living in female-headed households compared to male-headed households (International Bank for Reconstruction and Development, 2018). Additionally, black South Africans have the highest poverty rates. In 2015, 47% of households headed by black South Africans were poor, while only 23% of households headed by a mixed-race individual and less than 1% of households headed by a white individual were poor (International Bank for Reconstruction and Development, 2018).

### **2.4.3 Infant Mortality and SUDI in South Africa**

Data exist for infant mortality as a whole in South Africa, although accurate and current data regarding the incidence of SUDI in South Africa are not available (Dempers, Burger, Du Toit-Prinsloo, & Verster, 2018). In 1983, the rate of unexplained infant death in Cape Town was reported to be 3.05 deaths per 1,000 live births (Molteno, Ress, & Kibel, 1989). There was an approximately 20-year gap following that publication during which almost no scientific publications that evaluated SUDI or SIDS in South Africa were released (Dempers et al., 2018). In 2015, updated information reported that 0.6% of all deaths in South African children under one year old were due to SIDS, and 10.4% of deaths were due to other unspecified causes of mortality (Statistics South Africa, 2015).

More current data exist for infant mortality as a whole: South Africa's 2018 infant mortality rate was 29 deaths per 1,000 live births (The World Bank, 2019a). South Africa's rate is high

compared to other upper-middle income countries. Albania had eight deaths per 1,000 live births in 2018, Brazil had 13 deaths per 1,000 live births, and Iraq had 23 deaths per 1,000 live births (The World Bank, 2019a). These comparisons are significant; South Africa has a higher infant mortality rate than Iraq, which has been engaged in violent global and civil conflicts for decades. South Africa's figures are stratified by region, as seen in the perinatal mortality rate which differs between provinces (Figure 3) (The National Perinatal Morbidity and Mortality Committee, 2016). In terms of SIDS specifically, the rate in Cape Town, South Africa, is estimated to be one of the highest in the world at 3.41 deaths per 1,000 live births (Dempers et al., 2016).



**Figure 3 Perinatal Mortality Rate By Province**

(The National Perinatal Morbidity and Mortality Committee, 2016)

Although current data are not available on the specifics of SUDI in South Africa, some information is available regarding established and modifiable risk factors for infant sleep-related deaths, such as prone sleeping, co-sleeping, low birth weight, and smoking and alcohol use during pregnancy and around infants. A 1992 study in the Western Cape found that not only were co-sleeping and prone sleeping extremely prevalent, but they varied by ethnicity and SES (Potgieter

& Kibel, 1992). Rates of prone infant sleeping were 50% among whites, 58.7% among blacks, and 58.7% among coloreds (mixed race), 54.1% among families with higher levels of socio-economic wellbeing, and 69.2% among families with lower levels of socio-economic wellbeing. Additionally, rates of co-sleeping were 94% for black infants, 71% for colored infants, and 4% for white infants (Potgieter & Kibel, 1992). More current data from the Western Cape confirm these figures. Medical practitioners at the Western Cape Forensic Pathology Service observed that in almost all SUDI cases the infant was found deceased in the early morning and was co-sleeping on the night of their death (Dempers et al., 2018).

Low birth weight rate is considered to be an indicator for the socio-economic status of an area (The National Perinatal Morbidity and Mortality Committee, 2016). South Africa's low birth weight rate, that is, infants born at less than 5.5 pounds, was 13% in 2016, with varying rates across provinces. The rate in the Northern Cape, 20.7%, was almost twice of the rate of Limpopo at 10.6% (The National Perinatal Morbidity and Mortality Committee, 2016).

The risk of SIDS is nearly 12 times greater in pregnancies with combined exposure to smoking and alcohol that continued beyond the first trimester. This is especially significant because alcohol and tobacco use often co-occur (Elliott et al., 2019). A study of pregnant women attending midwife obstetric units in Cape Town found that 8.8% of the sampled women tested positive for at least one illicit drug and 19.6% tested positive for alcohol (Petersen Williams, Jordaan, Mathews, Lombard, & Parry, 2014). A similar study across South Africa reported that 45.9% of surveyed pregnant women were current smokers (Petersen, Steyn, Lombard, Everett, & Emmelin, 2009).

Although data about SUDI in South Africa are incomplete, the statistics regarding poverty and the risk factors allow for inferences. Almost 14 million individuals in South Africa live below

the poverty line. Families who live in poverty are less likely to have access to basic utilities and more likely to live in overcrowded housing and further away from a hospital. Rates of prenatal smoking and alcohol use are high, and mothers in low resource regions are more likely to give birth to low birth weight babies. Black South Africans are more likely to be poor, co-sleep with their infants, and place infants in the prone sleeping position. In summary, many of the modifiable risk factors for sudden infant death are present at high levels, especially among the poor. In the absence of a concentrated public health effort, this has resulted in the perfect storm for high rates of sudden infant death.

#### **2.4.4 Current Efforts**

Public research is lacking on causes and incidences of SUDI in South Africa (Van Deventer, Rossouw, & Du Toit-Prinsloo, 2016). However, researchers in South Africa have begun to study SUDI more closely in the last several years. A major part of the effort has been to institute a standardized autopsy and death scene investigation to combat the lack of data on causes of mortality (Dempers et al., 2016). South Africa does not routinely perform death scene investigations for SUDI cases, which has been attributed to the large burden of SUDI cases and lack of resources. SUDI death scenes were visited in only 59.2% of cases at one of the largest mortuaries in South Africa, and there were poor and inconsistent levels of documentation (Bennett, Martin, & Heathfield, 2019). Additionally, investigative protocols in SUDI cases differ greatly across several of the largest academic medical institutions (du Toit-Prinsloo et al., 2013).

Despite these difficulties, researchers have shown that viral infections play an important role in SUDI in South Africa. Multiple viruses have been detected in SUDI autopsy specimens, including enterovirus, influenza, and RSV (la Grange, Verster, Dempers, & de Beer, 2014). These



are important steps; however, more must be done to properly investigate and document SUDI deaths, and to disseminate relevant findings to medical and public health professionals and results to families. Notably, the South African Medical Journal reported the launch of South Africa's first infant death awareness campaign in 2003 ("First Sudden Infant Death Awareness Campaign Launched in South Africa," 2003). However, it is unclear if the campaign was ever evaluated or if it was successful in reducing infant deaths. Additionally, the Western Cape government does have a SIDS webpage that lists risk factors and preventative measures, yet it is unclear if this messaging is reaching parents or if there are any resources available to them (Western Cape Government, 2019).

### **3.0 Methods**

This thesis is based on a literature search designed to identify published literature about policies, interventions, programs, and models that aimed to prevent or decrease the incidence of Sudden Unexpected Death of Infants.

#### **3.1 Eligibility Criteria**

In order to be considered for inclusion, the study had to discuss sudden unexpected death in infancy; articles reporting on study populations over 12 months of age were excluded and articles that were not original research were excluded. The article had to report on a clinical trial, intervention, or program description, or describe and evaluate a public health campaign. Articles had to be written in English; there was no date limitation.

#### **3.2 Search Details and Data Collection**

Medline (Ovid) was searched with the assistance of a health sciences librarian with experience developing comprehensive searches. The date of the last search was December 20, 2019. A search was completed for sudden unexpected death in infancy (SUDI); the results were stratified by study methodology. The strategies and date searched can be found in Appendix A. Bibliographies of relevant articles were examined by the health sciences librarian (HVV) for studies not found through database search engines. EndNote (Clarivate) was used to store all

citations found in the search process and to check for duplicates. Search strategies and results were tracked using an Excel workbook designed specifically for systematic reviews (Von Ville, 2018). All articles were screened by AC using the Excel workbook (Von Ville, 2018). Data were collected and processed using an Excel workbook that incorporated a modified version of the TREND statement (CDC, 2018b).

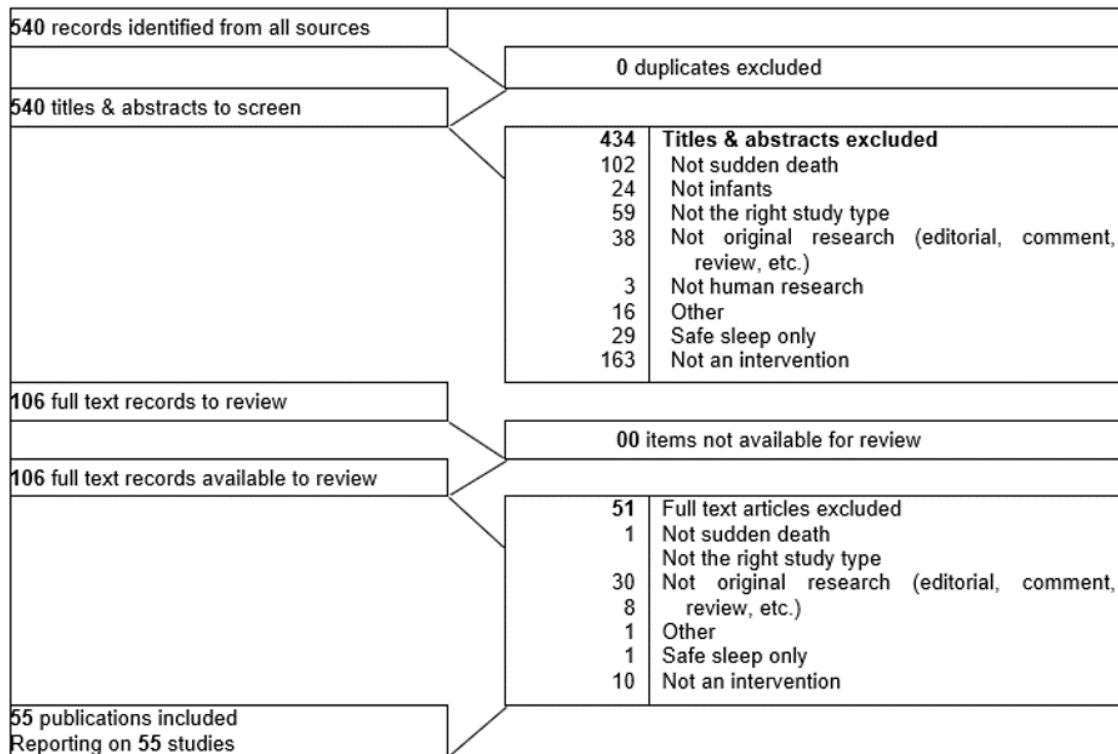
## 4.0 Results

### 4.1 Study Selection

Five-hundred and forty studies were screened and assessed for eligibility. After title and abstract screening, 434 studies were excluded (Figure 4). One hundred and two studies did not include sudden death, 24 had study populations that were not infants, 59 were not the right study type, 38 were not original research, three had non-human study populations, 29 focused only on safe sleep, 163 did not evaluate interventions, and 16 were excluded for other reasons.<sup>4</sup> This resulted in 106 studies for full text review, of which 51 were excluded. One study did not include sudden death, 30 were not the right study type, eight were not original research, one focused only on safe sleep, 10 did not evaluate interventions, and one study was excluded for other reasons; this left 55 articles for review.

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<sup>4</sup> Articles categorized as not the right study type had elements of the specified exclusion criteria. Examples include articles that described public health campaigns but did not evaluate them and articles that described ICD and electronic health record coding practices for sudden infant death.



**Figure 4. PRISMA Flowchart for Intervention Proposal for the Prevention of SUDI in South Africa**

## 4.2 Study Characteristics

The following characteristics were extracted for each of the 55 studies: title, year of publication, country of publication, type of intervention evaluated, description of study, results of study, conclusion of study (Appendix B). Additionally, each study was given a unique study identification number. The articles all included one or more of the following elements: evaluation of healthcare staff education interventions, parental education interventions, effectiveness of infant home monitoring devices, effectiveness of infant safe sleeping devices, description of evaluation of a public health campaign, evaluation of infant scoring systems, childcare center practices, and smoking restrictions.

Eight articles evaluated healthcare staff education interventions (Gelfer, Cameron, Masters, & Kennedy, 2013; Krugman & Cumpsty-Fowler, 2018; McMullen, Lipke, & LeMura, 2009; Price, Hillman, Gardner, Schenk, & Warren, 2008; Rasinski, Kuby, Bzdusek, Silvestri, & Weese-Mayer, 2003; Rocca Rivarola et al., 2016; Srivatsa, Eden, & Mir, 1999; Voos, Terreros, Larimore, Leick-Rude, & Park, 2015); three of the eight articles also included parental education (Rasinski et al., 2003; Rocca Rivarola et al., 2016; Srivatsa et al., 1999), and one was part of a public health campaign and included parental education (Krugman & Cumpsty-Fowler, 2018). All reported an increase in safe infant sleeping practices before and after hospital discharge.

Four articles evaluated the effectiveness of home infant monitoring devices (Emery, Waite, Carpenter, Limerick, & Blake, 1985; Franco, Szliwowski, Dramaix, & Kahn, 1999; Ramanathan et al., 2001; Tudehope & Cleghorn, 1984). These devices monitored infant breathing and reported mix results in terms of preventing or reducing obstructed breathing events.

Twelve articles evaluated parental education programs (Burd et al., 2007; Carlin et al., 2018; D'Halluin, Roussey, Branger, Venisse, & Pladys, 2011; Hutton et al., 2017; Issler, Marostica, & Giugliani, 2009; Krugman & Cumpsty-Fowler, 2018; McIntosh, Trenholme, Stewart, & Vogel, 2018; Moon et al., 2017; Moon, Oden, & Grady, 2004; Rasinski et al., 2003; Rocca Rivarola et al., 2016; Srivatsa et al., 1999). The programs utilized a range of education mediums, including books, brochures, and individual and group information sessions. All articles reported an increase in knowledge of safe sleep practices among parents after participating in an educational program.

Six articles evaluated safe sleeping devices, several in conjunction with parental education (Baddock et al., 2017; de Chalain, 2003; Hauck, Tanabe, McMurry, & Moon, 2015; McIntosh et al., 2018; Salm Ward, McClellan, Miller, & Brown, 2018; Sauseng, Kerbl, Thaller, Hanzer, &

Zotter, 2011). Providing a separate infant sleeping space was shown to be a viable alternative to bedsharing.

Six articles were categorized as other and were focused on identifying high risk infants, evaluating childcare center practices, and how smoking restrictions affect SIDS rate (Markowitz, 2008; Moon, Kotch, & Aird, 2006; Moon & Oden, 2003; Myerberg et al., 1995; E. M. Taylor, Spencer, & Carpenter, 1993; Zotter, Kerbl, Schwantzer, Kurz, & Einspieler, 2004).

Twenty-six articles described or evaluated a public health campaign in various countries (Barnes-Josiah et al., 2007; Carpenter et al., 1983; Cooper & Lumley, 1996; Cullen et al., 2000; Dwyer, Ponsonby, Blizzard, Newman, & Cochrane, 1995; Finau, Finau, Fuamatu, & Tukuitonga, 2003; Gibson, Dembofsky, Rubin, & Greenspan, 2000; Gibson et al., 1998; Hiley & Morley, 1994; Inbar et al., 2005; Kiechl-Kohlendorfer, Peglow, Kiechl, Oberaigner, & Sperl, 2001; Krugman & Cumpsty-Fowler, 2018; Malloy & Freeman, 2004; Markestad, Skadberg, Hordvik, Morild, & Irgens, 1995; Mehanni, Kiberd, McDonnell, O'Regan, & Mathews, 1999; Pickett, Luo, & Lauderdale, 2005; Ponsonby, Dwyer, Kasl, Cochrane, & Newman, 1994; Ponsonby, Dwyer, Kasl, Couper, & Cochrane, 1995; Schlaud et al., 1999; Scragg, Mitchell, Tonkin, & Hassall, 1993; Skadberg, Morild, & Markestad, 1998; Sperhake, Zimmermann, & Puschel, 2009; Spiers & Guntheroth, 1994; Wennergren et al., 1997; Wigfield, Gilbert, & Fleming, 1994). These public health campaigns, in Australia, Austria, Germany, Ireland, Israel, New Zealand, Norway, Scandinavia, the U.K., and the United States, are described in Appendix B. The number of studies from each country is outlined in Appendix C. The articles evaluated a range of outcomes after national or regional campaigns, including infant sleeping space, prone sleeping rates, bedsharing, and parental knowledge and practices.

### 4.3 Analysis of Articles

The articles reviewed for this paper provide guidance for successful programs and interventions for educating parents and healthcare providers and reducing SUDI rates and risk factors. Many of these articles are particularly relevant for South Africa. Infant sleeping spaces are important, and the distribution of a crib or safe sleeping space product in conjunction with education was associated with improved knowledge of risk factors and reduction of risky infant sleep practices (Hauck et al., 2015; McIntosh et al., 2018; Salm Ward et al., 2018). However, infant breathing monitoring devices are not as important. They are not reliable in terms of predicting or preventing apneic events, and there is evidence that parents become overly dependent on them (Emery et al., 1985; Ramanathan et al., 2001).

Scoring systems have the potential to reduce possible newborn deaths by identifying high risk infants (Carpenter et al., 1983; Taylor, Spencer, & Carpenter, 1993). They are useful in creating and implementing specific care plans for high-risk infants to reduce mortality, especially as high-risk behaviors have been associated with minority populations (Gibson et al., 2000; Inbar et al., 2005; Myerberg et al., 1995).

Education about risk factors and safe sleep practices for both healthcare providers and parents is crucial. Parents who see safe sleep practices modeled by providers in the hospital are more likely to practice safe sleep with their infant at home (Gelfer et al., 2013; Price et al., 2008; Rocca Rivarola et al., 2016). Implementing safe sleep education with healthcare providers improves parental compliance with safe sleep guidelines (Voos et al., 2015) and has the potential reduce infant death rates (Krugman & Cumpsty-Fowler, 2018). Similarly, parental education can have significant impacts on reducing SUDI risks, particularly for high risk and minority parents. Short education sessions with minority populations are effective in informing parents about safe



sleep practices and reducing bedsharing (Burd et al., 2007; Moon et al., 2017; Moon et al., 2004). Smoking is also a modifiable parental risk factors, and stronger restrictions on smoking in workplaces, restaurants, and child care centers, and higher cigarette prices and taxes, have been associated with reductions in SIDS (Markowitz, 2008).

The interventions and programs mentioned above can be useful in reducing SUDI risks, but public health campaigns are needed to produce large scale changes. Large campaigns, like the U.S. Back to Sleep campaign, can be effective yet costly. However, campaigns do not have to be elaborate; even simple campaigns can be helpful in reducing risk behaviors (Markestad et al., 1995). Straightforward strategies, such as use of pamphlets, are useful, but additional educational mediums can have greater impact (Cooper & Lumley, 1996). Media such as newspaper (Spiers & Guntheroth, 1994), TV, and radio (Kiechl-Kohlendorfer et al., 2001) have also been effective elements in reducing SIDS rates. Particular attention should be paid to minority and high risk populations; if social inequities are not considered in public health campaigns, gaps in SIDS ratios between social classes can widen (Pickett et al., 2005).

#### **4.3.1 Novel Examples**

Amongst the interventions and program evaluated, several unique examples emerged that warrant discussion. A New Zealand study created a sleeping wrap that fastens an infant to the mattress in the supine position (de Chalain, 2003), and another provided bassinets or infant sleeping baskets to indigenous women (Baddock et al., 2017). A Native American home visiting program provided parents with a baby blanket that had images of nine identified risk factors for SIDS (Burd et al., 2007) (Figure 5). Notable educational interventions included stickers on cribs in maternity centers in Argentina (Rocca Rivarola et al., 2016) and a poem distributed to new

mothers (Appendix E). These interventions provided more than the standard educational interventions or public health campaigns and are indicative of novel approaches that may be necessary to reduce sudden infant deaths, particularly among higher risk populations.



**Figure 5 Project Baby Blanket with Risk Factors**

(Burd et al., 2007)

#### **4.4 Unintended Consequences of Back to Sleep**

In 1994 the National Institute of Child Health and Human Development (NICHD), in collaboration with the AAP, the SIDS Alliance, the American Society for Investigative Pathology, the National Heart, Lung, and Blood Institute, and the Maternal and Child Health Bureau of the Health Resources and Services Administration, launched the Back to Sleep Campaign (U.S. DHHS, 2020b). The campaign, now called the Safe to Sleep Campaign, recommended that infants be placed on their backs to sleep to reduce the risk of SIDS. The NICHD sent campaign materials to hospitals, clinics, childcare centers, and WIC offices, and made announcements on TV and radio

stations. The SIDS rate in the U.S. has decreased by almost 50% since the start of the campaign and has been associated with an increase of infants sleeping in the supine position and a parallel decrease in infants sleeping prone (U.S. DHHS, 2020a).

However, some unintended consequences of the campaign have been reported. Infants who are placed in the supine sleeping position but do not have adequate time to practice lifting their heads while on their stomach, often called ‘tummy time’, are at risk for delayed early development and milestones such as rolling over, unsupported sitting, and crawling (Pelligra et al., 2005; Platt et al., 2000). Additionally, the AAP has acknowledged plagiocephaly, having an abnormally flat head shape, as a complication of supine sleeping. This happens when external forces are applied to an infant’s head and cause it to be misshapen (Miller, Johnson, Duggan, & Behm, 2011). Several studies have reported an increase in the number of infants with plagiocephaly in the last several decades, attributing the increase to the expanded number of infants sleeping in the supine position (Miller et al., 2011). However, these consequences can be mitigated through several practices, including alternating the end of the crib that an infant’s head is placed at, limiting time in car seats and infant carriers, alternating the side a baby is held during bottle feedings, and ensuring infants have enough supervised ‘tummy time’ while the infant is awake (Miller et al., 2011). These implications of supine sleep and mitigating practices are important considerations for any SUDI reduction program, especially among populations where parents may not have the time or resources to devote to these mitigating practices.

## **5.0 Proposed Program Outline**

Based on the literature review, this paper proposes a public health program that contains the following elements: implementation of a SUDI investigation protocol, healthcare provider and parental education, implementation of an infant screening system, home visits with bassinet distribution, and a focused SUDI prevention campaign.

### **5.1 SUDI Investigation Protocol**

South Africa lacks a standardized autopsy and death scene investigation protocol, and death scene documentation is inconsistent, as described earlier. The proposed public health intervention establishes an effective autopsy and death scene investigation protocol in order to obtain more data regarding the specifics of SUDI in South Africa. Elements to be included are adapted from Dempers et al., (2016). South Africa has an established Forensic Pathology Service, and these workers will be properly trained in carrying out death scene investigations. As previous studies have reported poor documentation practices, emphasis will be placed on accurate and consistent documentation. The CDC's infant death scene investigation guidelines provide a useful model for creating a death scene investigation protocol (Hanzlick, Jentzen, & Clark, 2007). The document establishes guidelines for recording and evaluating the scene, including taking photographs, collecting evidence, and interviewing witnesses, as well as collecting information about the infant and their sleeping arrangement, including the time the infant was found, the bedding environment, and infant age and ethnicity (Hanzlick et al., 2007).

The standardized autopsy protocol will include detailed external examinations, histology of major organ systems, bacteriology and viral cultures, HIV testing, and toxicology screening (Dempers, 2016). By establishing guidelines for autopsy and death scene investigations, pathology, medical, and public health professionals will be able to piece together a more accurate picture of SUDI in South Africa. Reliable statistics will enable public health officials to direct resources to the highest need groups and geographic areas, and continued collection of SUDI data can be evaluated to determine if public health efforts have been effective in reducing SUDI.

## **5.2 Healthcare Provider and Parental Education**

Providing safe sleep education for healthcare providers has been shown to improve compliance with safe sleep guidelines. Under the proposed plan, hospitals will develop educational units for all staff members who provide infant care, including doctors and nurses. Special attention will be paid to hospitals that service poor or rural communities. The educational units will present the basics of safe infant sleep, as recommended by the AAP and described above. Small crib cards can be placed on cribs within infant units to remind providers to place infants on their backs without any additional bedding or blankets. Infant units will be monitored following the educational units in order to ensure compliance with the safe sleep guidelines.

It is estimated that 90% of births in South Africa occur within health facilities under the supervision of a skilled professional (Parag, McKerrow, & Naby, 2014). Therefore, hospitals providing labor and delivery services are important focal points for educating parents. The period after birth is the first time many parents will see their infant being cared for, and this period will be critical for developing safe sleep habits after discharge, particularly for first-time parents.

Parents are likely to mimic the behaviors they see in the hospital; therefore, if they observe infant safe sleep practices, they will be more likely to practice safe sleep at home.

Parental education will consist of short, easy to understand sessions; quick educational sessions have previously been effective in informing parents about safe sleep practices and reducing bedsharing. Hospital staff members will be trained to verbally provide safe sleep information to new parents before they leave the hospital. If funding allows, parents may also be given an item to remind them about safe sleep practices, such as a crib sticker, infant t-shirt, or baby blanket (Barnes-Josiah et al., 2007; Burd et al., 2007; Rocca Rivarola et al., 2016).

### **5.3 Infant Screening System**

Infant screening or scoring systems can identify infants at high risk of sudden death. Various scoring systems have been developed and utilized, focusing on maternal characteristics, newborn medical indicators, or a combination of the two. The proposed plan calls for South Africa to develop a unique screening system tailored to the needs of the population, designed to screen for SUDI risk factors. The screening will be deployed during prenatal visits or in hospitals after an infant is born. The maternal factors can be evaluated prenatally or after the baby's birth, however, performing the screening prenatally may help healthcare providers take additional steps to prepare the mother for the arrival of the baby. The maternal factors in the screening will include maternal age and ethnicity, education level, marital status, maternal smoking during the pregnancy and planned smoking after delivery, and positive family history of chronic bronchitis or SIDS (Zotter et al., 2004). After birth, infants will be screened for birth weight and gestational age (Smith & White, 2006). Additionally, mothers will be asked about their socio-economic status and home

environment. They will be asked if the infant has a separate sleeping space with a firm mattress, or if the infant will be co-sleeping with other family members. Furthermore, they will be asked about access to electricity and a clean water source, if they are able to afford basic infant care items, family employment, and how many people will be living in the home with the infant. By asking these questions, the screener can loosely determine the financial status of the family. Taken together, the answers to these screening questions will describe the type of environment the infant will be brought into and how many SUDI risk factors the infant could potentially be exposed to. These questions in particular may be important to ask prenatally, as many of these risk factors could be mitigated before the baby arrives. If the family is unable to afford diapers, or does not have a crib for the baby, healthcare providers can connect families to the appropriate resources to prepare them for the birth of the baby.

This screening and assessment should not be designed to embarrass or criticize parents, but rather determine which infants are at high risk for SUDI in order to provide supports for the infants and their parents. Hospitals can determine how many positive responses results in a designation of ‘high-risk,’ keeping in mind that some of the answers will be more qualitative as opposed to quantitative, and screeners may need some guidance in terms of analyzing the family’s home situation.

Healthcare providers will work with families whose infants are designated ‘high risk’ to develop a care plan; specific care plans provided by doctors until the infant reaches age one have shown to lower neonatal mortality (Myerberg et al., 1995). The care plan may include tools for reducing SUDI risk factors, more frequent visits with a pediatrician, and home visits with a trained healthcare worker, described below.

#### **5.4 Home Visits with Bassinet Distribution**

Community health workers are recognized as a means of improving access to healthcare in rural areas (Mayosi & Benatar, 2014). Community health workers are individuals who are trained to provide basic health information and medical care to their own communities. Under the proposed plan, infants who are designated as high risk will receive bimonthly or weekly visits from trained community health workers. They can reinforce the SUDI risk reduction factors parents learned at the hospital and continue to support parents in making safe choices for their babies. Additionally, community health workers can examine infants for any underlying issues that may contribute to SUDI risk factors. Almost 34% of the poor in South Africa live over 12 miles from the nearest hospital, and community health workers can ensure infants are still receiving basic care despite the isolation. Incorporating community health workers is an important step in reaching the 10% of mothers who do not give birth in a hospital; they can receive SUDI education from their local community health worker.

Supine sleep positioning is perhaps the largest risk reduction method for SUDI. However, several other risk reduction factors, the absence of bedsharing and sleeping on a firm surface without loose bedding, all center around whether an infant sleeps alone in some sort of crib. In a country where 25% of the population lives below the poverty line and 61% of the poor live in overcrowded conditions, it is unreasonable to assume that parents will be purchasing the newest crib model on the market in anticipation of their newborn. Co-sleeping and bedsharing may often occur out of necessity, yet this practice is modifiable. Small bassinets placed in bed with parents can be used as an alternative to bedsharing (Baddock et al., 2018). This is a positive finding. However, even more encouraging, programs that provide parents with a crib or bassinet, in addition to education, have been shown to increase knowledge of risk factors and increase safe



sleep practices, particularly among high risk populations (Hauck et al., 2015; McIntosh et al., 2018; Ward et al., 1986). Families that are low income or have infants designated as high risk will receive some type of infant sleeping space in addition to the education provide by the community health worker.

The choice of infant sleeping space device is complex. The AAP recommends infants be placed in a crib on a firm mattress alone, with no additional bedding or sheets. Many alternatives to cribs currently exist, including baby loungers and three-sided bassinets that attach to the side of an adult bed. These types of devices are generally less expensive than traditional cribs and take up much less space, making them appealing for families living in smaller spaces. However, many of these are not recommended by leading pediatric groups because of their soft bottoms, soft sides, and solid elevated sides. Ideally families would be given a stand-alone bassinet for their infant, which can be placed in the same room as other sleepers but is completely separated. However, families may not have room for a stand-alone bassinet, or may not be willing to use it. A small, movable, and flexible bassinet with firm bottoms and sides may be better suited to families. More work should be done in this area to determine what would be most effective for families.

#### **5.4.1 Health Belief Model and Social Cognitive Theory**

The Health Belief Model was originally developed in the 1950s to explain the failure of people to participate in programs designed to prevent and detect disease (Champion & Sugg Skinner, 2008). If individuals see themselves as susceptible to a condition, believe that the condition has potentially serious consequences, and are presented with a course of action that they believe would be reduce their susceptibility and have anticipated benefits, they are likely to take that course of action (Champion & Sugg Skinner, 2008). The goal of the public health campaign,

combined with parental education, infant screening, home visits, and bassinet distribution, is to make it easy for parents to practice SUDI risk reduction measures. The Health Belief Model states that if this course of action of practicing risk reduction measures is made easy and beneficial for parents, and outweighs any barriers, they will take it.

Social cognitive theory describes the influence of individual experiences, actions of others, and environmental factors on individual health behaviors. The theory describes how providing tools, resources, or environmental changes can make new behaviors easier to perform (McAlister, Perry, & Parcel, 2008). Facilitating the implementation of new practices requires the provision of new structures or resources that enable behaviors and overcome barriers. All parts of the proposed intervention aim to change parents' environment to support implementing SUDI risk reduction factors. Parental education, an infant screening system, home visits, and a public health campaign provide environmental changes and new resources to make SUDI risk reduction practices easier to perform. The bassinet distribution provides a physical resource that enables parents to place infants in their own sleeping spaces.

## **5.5 Public Health Campaign**

The interventions and programs mentioned above can be useful in reducing SUDI risks, but public health campaigns are needed to produce large scale changes. Public health officials in South Africa can begin creating appropriate health communication materials for minority and high-risk populations, particularly low-income families and families that live in urban townships and in rural areas far from health facilities. Poor families in South Africa have higher rates of prone sleeping, a SUDI risk factor, than higher income families. As described above, the poor are

more likely to live further from hospitals and have higher rates of overcrowding. In overcrowded homes it may be difficult for infants to sleep in their own sleep space without bedsharing. Additionally, mothers who live in poor regions are more likely to give birth to low birth weight babies, a SUDI risk factor. Black families are more likely to live in poverty and have high rates of both co-sleeping and prone sleeping.

Health communication materials will focus on the modifiable risk factors most prevalent in South Africa: prone sleeping, co-sleeping, and smoking and alcohol use during pregnancy and around infants. These messages will reinforce the information parents are receiving during hospital education and home visits and will be distributed through multiple media outlets. It may be helpful to conduct focus groups to determine what types of media would be most appropriate.

### **5.5.1 Health Literacy**

Health literacy is the degree to which people have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Batterham, Hawkins, Collins, Buchbinder, & Osborne, 2016). If individuals have trouble reading or understanding their healthcare providers, they will be less likely to follow recommended practices. In South Africa only 53.4% of the poor over age 25 have completed primary school (International Bank for Reconstruction and Development, 2018). Therefore, messages must be designed to be understood by individuals of all literacy levels. Additionally, it is important to understand how discussions about health happen and where people find and interpret health information before beginning a public health intervention. Health literacy can often be determined by evaluating the connectedness of a community. A study in India found that the average literacy level for women in a village was a stronger correlate for childhood immunization rates than the

literacy level of individual mothers (Parashar, 2005). Therefore, it is important that this type of campaign is done on a community level, with the integration of a home visiting system by a member of the community. Additionally, successful health campaigns devote less time to arguing the seriousness of the health issue and more time explaining the availability of ways to cope with it. Messages can stress the efficacy of taking risk reducing steps and provide explicit instructions on how the person can take small steps of risk reduction (McGuire, 1984). Focusing on educating parents about the modifiable SUDI risk reduction factors will result in more positive changes than simply telling them about the seriousness of SUDI.

### **5.6 Addressing Inequities**

Inequalities in basic resources, income, and access to healthcare are significant in South Africa. Although data on SUDI are lacking in South Africa, the available data on individuals living in poverty describe a large group of families that lack the resources necessary to reduce their infants' risk of SUDI. All families can benefit from a SUDI public health campaign, however families living in poverty should be specifically targeted. In fact, if social inequities are not considered in public health campaigns, gaps in SIDS ratios between social classes can widen (Pickett et al., 2005). Public health officials must be sure not to leave the most vulnerable families behind and provide them with the tools to keep their infants safe.

## **6.0 Conclusion**

### **6.1 Summary**

The global public health community has made great strides in reducing infant mortality. However, SUDI remains a significant concern, particularly among families living in poverty in South Africa. The true epidemiological cause of SUDI is not known, and various public health interventions and programs have attempted to reduce rates of SUDI with differing degrees of success. These efforts include healthcare provider and parental education, infant monitoring devices, infant safe sleeping devices, and public health campaigns. A literature search review of 55 articles was utilized to propose a program outline for reducing SUDI in South Africa. The proposed program includes the implementation of a SUDI investigation protocol, healthcare provider and parental education, an infant screening system, home visits with bassinet distribution, and a public health campaign. The program should be targeted towards families living in poverty with limited resources to implement SUDI risk reduction practices.

### **6.2 Limitations**

The last literature search was performed in December 2019; more recent studies may have been missed. Additionally, the search criteria were limited to English and there is the potential for missing studies that were published in other languages. Conference papers were not included. Many of the articles differed in terms of power and sample size; some articles had thousands of

participants while others had a few dozen. Similarly, some articles were published several decades ago, while others were published in the last few years. Therefore, the quality of the articles obtained from the literature search could have been more robust.

There is a lack of research and reliable data on SUDI in South Africa. Additionally, most the articles included were conducted and written in the United States or Europe. Public health officials cannot assume that interventions implemented in high-resource countries will be effective in South Africa. More research must be done to address the literature and knowledge gaps to better understand the SUDI situation in South Africa and to determine what types of interventions would be most valuable.

This is meant to be a preliminary plan laying the groundwork for a SUDI reduction campaign in South Africa. The citizens, medical professionals, and public health officials in South Africa know their communities best. They are the ones who can determine if the plan presented is feasible and logical for their country.

### **6.3 Directions for Future Research**

Many areas for future research have been identified; perhaps most important is the need for more accurate data about the numbers and causes of SUDI in South Africa. Specifically, more research is needed to determine the connection between SUDI and prenatal tobacco, alcohol, and illicit drug use. Further, it may be helpful to explore the role of total fertility in relation to infant death. Additional research is needed to determine what types of bassinets would be most appropriate for families, as well as what types of media would be best for circulating the public health campaign messaging.

Future projects may consider how the ethnic backgrounds of individuals in South Africa affect the survival of infants. Higher risk for SUDI is well documented among poor and ethnic minority families, however this dynamic is particularly important for South Africa. In a country where lines were traditionally drawn between black and white individuals, families from other ethnic backgrounds may not be receiving the appropriate attention they deserve. Ethnic groups other than whites and blacks, such as Asians and Coloureds, may affect the income and poverty rates in the various provinces they live in. There may be much to learn from looking at SUDI through the perspective of other ethnic groups.

#### **6.4 Advocacy**

South Africa is filled with rich culture, beautiful beaches, distinct ecosystems, and lush vineyards. However, it is clear that many citizens of South Africa have been left behind. Apartheid ended a mere 25 years ago, and it cannot be expected that the effects of such a severe system of discrimination will be erased in such a relatively short period of time. Therefore, public health officials must advocate for the most disadvantaged citizens and increasing access to education is one of the most important ways of advocating for change. By equipping healthcare providers and parents with the knowledge and resources necessary to keep infants safe, they will be empowered to make choices that result in better health outcomes. South Africa has an opportunity to implement public health programs that will reduce their infant mortality rates and contribute to lowering the global infant mortality rate.

## Appendix A Search Strategy and Results for SUDI

### Medline® search strategy

<b>Provider/Interface</b>	Ovid
<b>Database</b>	Medline®
<b>Date searched</b>	December 20, 2019
<b>Database update</b>	Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to December 19, 2019
<b>Search developer(s)</b>	Helena M. VonVille; Amanda Carpenter
<b>Limit to English?</b>	Yes
<b>Date Range</b>	No date limits set
<b>Publication Types</b>	
<b>Search filter source</b>	<a href="https://www.yopl.info/post/ovid-medline-research-methodology-search-filters-and-a-couple-of-nifty-limits">https://www.yopl.info/post/ovid-medline-research-methodology-search-filters-and-a-couple-of-nifty-limits</a>

1.	("sudden unexpected death In infancy" or "sudden unexpected early neonatal death" or sudi or SUEND).ti,ab,kw.
2.	death, sudden/ or sudden infant death/
3.	1 or 2
4.	infant/ or exp infant, newborn/
5.	(infant or infants or neonatal or newborn or newborns or perinatal).ti,ab,kw.
6.	4 or 5
7.	3 and 6
8.	limit 7 to english language
9.	South Africa/
10.	(south africa or "cape town" or johannesburg).ti,ab,kw.
11.	9 or 10
12.	8 and 11
13.	evaluation studies/ or "evaluation studies as topic".pt. or program evaluation/ or validation studies/ or "validation studies as topic".pt. or (effectiveness or intervention or (pre- adj5 post-) or (pretest adj5 posttest) or (program* adj6 (evaluate or evaluated or evaluates or evaluating or evaluation or evaluations or evaluator or evaluators))).ti,ab,kw.
14.	("adaptive clinical trial" or "clinical trial" or "clinical trial, phase i" or "clinical trial, phase ii" or "clinical trial, phase iii" or "clinical trial, phase iv" or "controlled clinical trial" or "multicenter study" or "randomized controlled trial").pt. or double-blind method/ or "clinical trials as topic"/ or "clinical trials, phase i as topic"/ or "clinical trials, phase ii as topic"/ or "clinical trials, phase iii as topic"/ or "clinical trials, phase iv as topic"/ or "controlled clinical trials as topic"/ or "non-randomized controlled trials as topic"/ or "Equivalence Trials as Topic"/ or "Intention to Treat Analysis"/ or "Pragmatic Clinical Trials as Topic"/ or randomized controlled trials as topic/ or early termination of clinical trials as topic/ or multicenter studies as topic/ or ("phase I" or "phase II" or "phase III" or "phase IV" or "phase 1" or "phase 2" or "phase 3" or "phase 4").ti,ab,kw. or ((randomi?ed adj7 trial*) or (controlled adj3 trial*) or



	(clinical adj2 trial*) or ((single or doubl* or tripl* or treb*) and (blind* or mask*))).ti,ab,kw. or ("4 arm" or "four arm").ti,ab,kw.
15.	13 or 14
16.	8 and 15
17.	focus groups/ or interviews as topic/ or narration/ or qualitative research/ or ((face-to-face or guided or in-depth or indepth or informal semi-structured or semistructured or structured or unstructured) adj3 (discussion* or interview* or questionnaire*)).ti,ab,kw. or (ethnograph* or "field work" or fieldwork or focus group* or key informant* or qualitative).ti,ab,kw.
18.	8 and 17

## Appendix B Selected Study Summary

**Table 1. Selected Study Summary**

Study ID	Author Title Year of Publication Country/Region	Type of Intervention Evaluated (public health campaign, parental education, healthcare staff education, sleeping space device, infant monitoring device, other)	Description	Results	Conclusion
1	McIntosh, Trenholme, Stewart, Vogel Evaluation of a sudden unexpected death in infancy intervention programme aimed at improving parental awareness of risk factors and protective infant care practices 2017, New Zealand	parental education sleeping space device	240 Maori and Pacific women were randomized to Pepi-pod sleep space program or to control group with usual care	<ol style="list-style-type: none"> <li>1. knowledge of smoking and bed sharing as SUDI risks improved after intervention for both groups</li> <li>2. provided baby beds were used regularly by 46% of infants at 2 months post intervention and 16% at 4 months post intervention</li> </ol>	Bedsharing and knowledge improvement were similar irrespective of group
2	Ward, McClellan, Miller, Brown Evaluation of a Crib Distribution and Safe Sleep Educational Program to Reduce Risk of Sleep-Related Infant Deaths 2018, U.S.	parental education sleeping space device	women that were pregnant or who had recently given birth & demonstrated financial need participated in a one time, group-based safe sleep educational program and received a crib	<ol style="list-style-type: none"> <li>1. knowledge of recommendations regarding sleep position, surface, environment, smoking, breastfeeding, and pacifier use increased significantly</li> <li>2. proportion of recommended practices increased significantly</li> </ol>	Group-based, safe sleep educational programs can be effective in reducing risky infant sleep practices

**Table 1 Continued**

3	Tudehope, Cleghorn Home monitoring for infants at risk of the sudden infant death syndrome 1984, Australia	infant monitoring device	31 infants at risk of SIDS were monitored at home with chest movement detection monitors or thoracic impedance monitors	<ol style="list-style-type: none"> <li>1. genuine apnoeic episodes were reported by 21 families, 13 infants required resuscitation</li> <li>2. false alarms happened with 61% of infants, malfunction occurred often</li> </ol>	All of the infants lived, the sample size was too small to conclude whether home monitoring prevented any SIDS cases
4	Carlin, Abrams, Mathews, Joyner, Oden, McCarter Jr., Moon The impact of health messages on maternal decisions about infant sleep position: a randomized controlled trial 2019, U.S.	parental education	1,194 African American mothers who had recently given birth received standard messaging about AAP-recommended sleep practices or enhanced messages about AAP-recommended sleep practices with an emphasis on reducing SIDS risk. They were followed up with months later	<ol style="list-style-type: none"> <li>1. the proportion of infants placed supine gradually decreased over the first 6 months but was not changed by enhanced education</li> <li>2. assignment to standard or enhanced messaging did not impact sleep position but parental knowledge of recommended sleep position was high in both groups</li> </ol>	Even though mothers may be aware of, and plan to follow safe sleep recommendations, there are many factors which contribute to the change in sleep position over the first 6 months of life.
5	Cooper, Lumley Mothers' knowledge of the risk factors and anxiety about SIDS 1995, Australia	public health campaign	339 mothers who had recently given birth were surveyed to assess the impact on mothers' knowledge and anxiety of a health promotion campaign on SIDS risk factors	<ol style="list-style-type: none"> <li>1. the recall rate increased as the campaign progressed</li> <li>2. receiving the campaign pamphlet was associated with an increased recall of risk factors</li> </ol>	The campaign pamphlets were effective in increasing knowledge of SIDS risk factors, but further discussion between healthcare providers and patients is needed, specifically to address anxiety among new mothers

**Table 1 Continued**

6	<p>Spiers, Guntheroth          Recommendations to avoid the prone sleeping position and recent statistics for sudden infant death syndrome in the united states          1994, U.S.</p>	public health campaign	<p>a recommendation supporting the prone sleep position was placed in a widely read newspaper in an effort to reduce the incidence of SIDS</p>	<p>1. in the 8 months following the article, the incidence of SIDS fell by 52% in the highest county of readership          2. in the 12 months following the initial 8 months, the number of SIDS cases was reduced to half the previous annual average</p>	<p>A national campaign to inform parents of the risk of prone sleeping in early infancy should be given serious consideration</p>
7	<p>Franco, Szilwowski, Dramaix, Kahn          Decreased Autonomic Responses to Obstructive Sleep Events in Future Victims of Sudden Infant Death Syndrome          1999, U.S.</p>	infant monitoring device	<p>50 infants participated in heart rate monitoring to evaluate changes in the autonomic nervous system in response to obstructive events</p>	<p>1. future SIDS victims had significantly more obstructive apneas than control infants</p>	<p>Future SIDS victims were characterized by different autonomic status and autonomic responses to obstructive apneas during sleep when compared to control infants</p>
8	<p>Carpenter, Gardner, Jepson, Taylor, Salvin, Sunderland, Emery, Pursall, Roe          Prevention of Unexpected Infant Death: Evaluation of the First Seven Years of the Sheffield Intervention Programme          1983, U.K.</p>	public health campaign	<p>452 infants were scored at birth for risk of SIDS, half of those identified as high risk received follow up through home health visitors, special clinics, and primary care teams</p>	<p>1. possible preventable deaths fell from 5.2 death to 1.9 deaths per 1,000 live births.          2. the reduction in mortality was attributed directly to the effect of increase home visiting of high-risk infants</p>	<p>A scoring system opens up the potential for reducing possible preventable infant deaths</p>
9	<p>Voos, Terreros, Larimore, Leick-Rude, Park          Implementing safe sleep practices in a neonatal intensive care unit          2015, U.S.</p>	healthcare staff education	<p>an intervention was developed to bring a safe sleep education model to a NICU and increase the percentage of eligible infants in a safe sleep environment</p>	<p>1. 21% of eligible NICU infants were in a safe sleep environment at baseline, this increased to 88% after the education intervention and reported observation</p>	<p>With formal staff and family education, optional wearable blanket, and data sharing, safe sleep compliance increased, and patient safety improved</p>

**Table 1 Continued**

10	<p>McMullen, Lipke, LeMaura Sudden Infant Death Syndrome Prevention: A Model Program for NICUs 2008, U.S.</p>	healthcare staff education	<p>a SIDS prevention program, including the introduction of sleep sacks, was instituted to increase neonatal nurses' knowledge and positively influence how parents place their infants to sleep</p>	<p>1. initially 98% of infants slept supine, 93% slept in sleep sacks in open cribs 2. after introducing sleep sacks, 100% of infants in open cribs sleep supine wearing a saddle or sleep sack</p>	<p>This program can easily be replicated to enhance neonatal nurses' knowledge about SIDS prevention</p>
11	<p>Krugman, Cumpsty- Fowler A Hospital-Based Initiative to Reduce Postdischarge Sudden Unexpected Infant Deaths 2018, U.S.</p>	<p>public health campaign healthcare staff education parental education</p>	<p>increased exposure to the County Health Department's safe sleep alert in order to increase exposure to safe sleep teaching for NICU nurses and parents</p>	<p>1. average death rate fell from 1.08 deaths per 1,000 live births to 0.48 deaths 2. average number of deaths between deliveries increased from 1 in every 584 deliveries to 1 in every 1,420 deliveries</p>	<p>A comprehensive sleep safety culture change be effectively integrated into a nursery setting over time. Repeated messaging and education by the nursery staff has the potential to play a role in reducing sleep-related deaths</p>

**Table 1 Continued**

12	<p>Mehanni, Kiberd, McDonnell, O'Regan, Matthews Reduce the risk of cot death guidelines: the effect of a revised intervention programme 1999, Ireland</p>	public health campaign	<p>A March 1992 pamphlet with safe sleep guidelines was revised and redistributed in 1995, parents were interviewed before and after the pamphlet update</p>	<p>1. in both sets of interviews the media was the most frequent source of information for parents, followed by medical sources &amp; public health nurses 2. after the pamphlet update more parents reported putting their babies to sleep on their backs, but they used heat more frequently 3. the updated pamphlet had less effect on further changing parents' practices, but the overall effect of the education program was successful in yielding a low percentage of babies sleeping prone</p>	<p>Health Professionals should be updated regularly regarding the guidelines to reduce the risks of SIDS. The monitoring of the risk awareness of the public, the uptake of the recommendations and their effective dissemination should be an ongoing process to facilitate a constant improvement in changing childcare practices</p>
13	<p>Scragg, Mitchell, Tonkin, Hassal Evaluation of the cot death prevention programme in South Auckland 1993, New Zealand</p>	public health campaign	<p>A national cot death prevention program aimed to reduce the prevalence of 4 modifiable risk factors, 200 mothers of infants were interviewed regarding risk knowledge after the program and compared to mothers interviewed before the program</p>	<p>the following percentage of mothers knew that these were risk factors for cot death prone sleeping position: 95.5% maternal smoking: 89.4% lack of breastfeeding: 63.1% infant sharing bed with another person: 68%</p>	<p>Infant care practices are changing and there is a need for continuing efforts, especially relating to maternal smoking and the practice of infants sharing a bed with another person</p>

**Table 1 Continued**

14	Wigfield, Gilbert, Fleming SIDS: risk reduction measures 1994, U.K.	public health campaign	Two population-based studies evaluating a national campaign to increase public awareness of risk factors for SIDS	<ol style="list-style-type: none"> <li>1. Prevalence of prone sleeping fell from 60% to 28%</li> <li>2. The relative importance of smoking and bottle feeding increased</li> <li>3. The SIDS rate fell from 3.5 deaths per 1,000 live births to 1.7 deaths</li> </ol>	Significant reductions in mortality have followed initial campaigns but in order to maintain them the message should be regularly renewed using appropriate and effective channels of communication to target high risk families in the community
15	Cullen, Kiberd, McDonnell, Mehanni, Matthews, O'Regan Sudden infant death syndrome--are parents getting the message? 2000, Ireland	public health campaign	Department of health launched an intervention designed to inform parents of the risks of SIDS, parents of infants were interviewed to determine if they were following recommended practices	<ol style="list-style-type: none"> <li>1. 41% of infants still placed on side to sleep, first time parents more likely to place infants on back</li> <li>2. over 60% of infants were exposed to one or more adults smoking in the home despite parental knowledge of association with SIDS</li> <li>3. 68% of infants were overwrapped at night</li> <li>4. 13% of infants regularly co-slept with parents</li> </ol>	Future programs should provide clear information regarding infant practices, should ensure regular updating of medical personnel so they can instruct families on current best practices

**Table 1 Continued**

16	Zotter, Kerbl, Schwantzer, Kurz, Einspieler Sudden Infant death syndrome risk questionnaire: a mirror of parental awareness rather than a prospective diagnostic tool 2004, Austria	other	A scoring system was developed that aimed to identify infants at risk by a structured questionnaire, later applied to evaluate individual SIDS risk scores and compare SIDS rates in the population that had access to the questionnaire with the population without access	1. the incidence of SIDS was significantly higher in the non-responding group than in the responding group	The value of any questionnaire used for SIDS prevention may be limited by the existence of a non-compliant population which presents a risk group and should be targeted by other preventive measures
17	Wennergren, Alm, Oyen, Helweg-Larsen, Milerad, Skjaerven, Norvenius, Lagercrantz, Wennborg, Saltveit, Markestad, Irgens The decline in the incidence of SIDS in Scandinavia and its relation to risk-intervention campaigns 1997, Sweden, Norway, Denmark	public health campaign	Campaigns were introduced to reduce the risk factors for SIDS, 244 families with SIDS cases and 869 matched control families filled out questionnaires in Norway, Denmark, and Sweden	1. after the campaign, the SIDS incidence decreased from 2.3 deaths per 1,000 live births in Norway, 1.6 deaths in Denmark, and 1.0 deaths in Sweden to 0.6 deaths per 1,000 live births or fewer in all the Scandinavian countries 2. Decline in prone sleeping position and post neonatal mortality in all 3 countries	The greatest potential methods for further reducing SIDS are changing the sleeping position from side to back and reducing maternal smoking
18	Taylor, Spencer, Carpenter Evaluation of attempted prevention of unexpected infant in very high-risk infants by planned health care 1993, U.K.	other	The Sheffield scoring system was used to identify 396 infants as being "very high risk" of SIDS; the infants received an intensive program of healthcare including weekly home visits	1. significantly fewer deaths occurred among the high-risk infants than were expected by regression analysis or than occurred in the best available control group with comparable scores	Robust programs of intervention may prevent some deaths in vulnerable infants



**Table 1 Continued**

19	Markestad, Skadberg, Hordvik, Morild, Irgens Sleeping position and sudden infant death syndrome (SIDS): an intervention programme to avoid prone sleeping 1995, Norway	public health campaign	Parents of infants and parents of SIDS victims were interviewed in a prospective study 3 years before and after a campaign in Hordaland County to discourage prone sleeping	1. 64% of infants were placed prone before the campaign versus 8% after 2. the rate of SIDS decreased from 3.5 to 1.6 deaths per 1,00 live births	Sleeping placement behaviors may be changed rapidly by means of a simple campaign
20	Ramanathan, Corwin, Hunt, Lister, Tinsley, Baird, Silvestri, Crowell, Hufford, Martin, Neuman, Weese-Mayer, Cupples, Peucker, Willinger, Keens Cardiorespiratory Events Recorded on Home Monitors, Comparison of Healthy Infants with those at Increased Risk for SIDS 2001, U.S.	infant monitoring device	A longitudinal study of 1,079 infants classified as healthy or increased risk of SIDS were monitored with cardiorespiratory monitors to detect apnea and obstructed breathing	1. events exceeding conventional alarm thresholds occurred in 41% of infants 2. of these events, 10% of infants had extreme events and of those events with apnea, 70% included at least 3 obstructed breaths 4. the frequency of at least 1 extreme event was similar in all term infants, but preterm infants were at increased risk of extreme events	Conventional events were common even in healthy term infants, extreme events were common only in preterm events but were likely not immediate precursors to SIDS
21	Skadberg, Morild, Markestad Abandoning prone sleeping: effect on the risk of sudden infant death syndrome 1997, Norway	public health campaign	A population-based case reference study involving infants dying suddenly and healthy infants, evaluating the long-term effects of a campaign to avoid prone sleeping 4 years before the start of the study	1. SIDS rate declined from 3.5 deaths per 1,000 live births to 0.3 deaths as prone sleeping as the preferred sleep position dropped from 64% to 8% 2. of the reference infants, 1.4% were usually placed prone to sleep, nearly half were placed supine 3. of the 5 SIDS victims, 1 usually slept prone and 3 were placed prone for their last sleep	SIDS is rare when prone sleeping is avoided

**Table 1 Continued**

22	Moon, Oden, Grady Back to Sleep: An Educational Intervention with Women, Infants, and Children Program Clients 2004, U.S.	parental education	310 African American parents/caregivers participated in trained healthcare educator led 15-minute session about safe infant sleep and performed pre and post session surveys. Parents were interviewed 6 months after the session and their responses were compared with a control group	<ol style="list-style-type: none"> <li>1. before the session more than half of the infants reportedly slept on their backs, only 28.1% of parents initially believed prone sleeping increases the risk of SIDS</li> <li>2. after the session 85.3% of parents planned to place the infant on their back and 55.7% believed prone sleeping increases the risk of SIDS</li> <li>3. when compared with the control group 6 months after the session, parents who attended the session were more likely to place infants on their backs, less likely to bedshare, and more likely to be aware of back to sleep recommendations</li> </ol>	15 minute educational sessions with small groups of African American parents are effective in informing parents about the importance of safe sleep position and changed parents behavior, sustained for the 6 months of infant life
23	Moon, Oden Back to Sleep: Can we Influence Child Care Providers? 2003, U.S.	other	96 childcare providers completed a survey, participated in a 60 minute educational in-service, and received a 6 month follow up interview to determine if the program was effective in providing basic SIDS information and changing child care practices	<ol style="list-style-type: none"> <li>1. after the in-service, providers using the supine sleep position exclusively increased from 44.5% to 78.1%</li> <li>2. 85% of centers placed infants exclusively supine for 6 months after intervention</li> <li>3. awareness of AAP recommendation of preferred supine position increased from 47.9% to 78.1%</li> <li>4. percentage of centers reporting written sleep position policies increased from 18.8% to 44.4%</li> </ol>	A targeted education in-service for childcare providers is effective in increasing awareness and knowledge, changing childcare provider behavior, and promoting development of written position policies

**Table 1 Continued**

24	<p>Rasinki, Kuby, Bzdusek, Silvestri, Weese-Mayer  Effect of a Sudden Infant Death Syndrome and Risk Reduction Education Program on Risk Factor Compliance and Information Sources in Primarily Black Urban Communities  2002, U.S.</p>	<p>healthcare staff education  parental education</p>	<p>Surveys were administered before and after a SIDS risk reduction education program targeted Black communities in neighborhoods, healthcare settings, schools, clinics, and churches</p>	<p>1. despite the educational initiative, Blacks increased their use of pillows, bedding, etc. as compared with whites  2. the observation of infant sleep position in hospital did not have an effect on behavior after discharge</p>	<p>The targeted educational initiative revealed some progress, but the findings suggest that cultural explanations for specific infant care practices must be more clearly understood to close the gap between knowledge and compliance regarding SIDS risk factors</p>
25	<p>Myerberg, Carpenter, Myerberg, Britton, Bailey, Fink  Reducing Postneonatal Mortality in West Virginia: A Statewide Intervention Program Targeting Risk Identified at and after Birth  1995, U.S.</p>	<p>other</p>	<p>Two interventions were aimed at infants at the greatest risk of mortality; one group received usual care while the infants in the second group were linked with physicians who provided specific care plans and followed the infants for 1 year</p>	<p>1. the odds ratios for overall post neonatal mortality and SIDS in identified high risk infants compared with low risk infants were 6.2 and 11.2  2. during the program there was a 21.4% reduction in the trend of yearly standardized mortality ratios</p>	<p>Ensuring affordable, available, accessible, and acceptable care for a small group of at-risk infants was associated with a dramatic drop in overall post neonatal mortality</p>
26	<p>Schlaud, Eberhard, Trumann, Kleeman, Poets, Tietze, Schwartz  Prevalence and Determinants of Prone Sleeping Position in Infants: Results from Two Cross-Sectional Studies on Risk Factors for SIDS in Germany  1999, Germany</p>	<p>public health campaign</p>	<p>Parents of infants in two states in Germany were asked to fill out a survey about infant care practices after a national campaign, these results were compared to parents in other countries where no intervention campaign had taken place</p>	<p>1. Prevalence of prone sleeping decreased from 37.6% to 8.7% in the German population and from 44.1% to 32% in the Turkish immigrant population</p>	<p>Although the information on prone sleeping being a risk factor for SIDS became well known among the population, subgroup specific public intervention campaigns may be needed to reduce the prevalence of prone sleeping further in countries where no</p>

**Table 1 Continued**

					national campaigns have been initiated
27	Hiley, Morley Evaluation of a government's campaign to reduce risk of cot death 1994, U.K.	public health campaign	Questionnaires were sent to two randomly selected groups of 450 mothers of infants, the first group having given birth 8 months before the campaign and the second group having given birth after the campaign. The way mothers cared for infants was compared before and after the campaign.	<ol style="list-style-type: none"> <li>1. Infant sleeping position changed after the campaign; older babies were more likely to sleep on their backs</li> <li>2. Quilts were used less often after the campaign, use increased with baby age</li> </ol>	Although the incidence of cot death has decreased dramatically, the risks have not been reduced for all babies
28	Ponsonby, Dwyer, Kasl, Couper, Cochrane Correlates of prone infant sleeping position by period of birth 1994, Tasmania	public health campaign	5,925 infants at 6 major hospitals in the state, representing 93% of live births, were assessed using a scoring system to predict those at higher risk of SIDS. Interviews were conducted at the hospital, at home, and by phone to assess the impact of an intervention to avoid the prone sleeping position	<ol style="list-style-type: none"> <li>1. The usual prone sleeping position was more closely associated with the following factors after the intervention; teenage motherhood, low maternal education, paternal unemployment, unmarried motherhood, non-specialist antenatal care, poor smoking hygiene, bottle feeding</li> </ol>	The results support the concept that modifiable risk factors for disease tend to be associated with each other. This was no evident in the population before the intervention, before the prone sleeping position became a well-known SIDS risk factor

**Table 1 Continued**

29	<p>Emery, Waite, Carpenter, Limerick, Blake Apnoea monitors compared with weighing scales for siblings after cot death 1985, U.K.</p>	<p>infant monitoring device</p>	<p>Randomized control trial carried out in addition to support measures given to parents with a child whose older sibling suffered cot death. Apnoea monitors were used on one group and weighing scales in the other, parents kept track of infant symptoms and received health visits weekly</p>	<ol style="list-style-type: none"> <li>1. Many false alarms in the monitor group</li> <li>2. 11% fewer symptoms were reported by parents of children on monitors than parents of children weighed daily</li> <li>3. 60% of parents were reluctant to give up the monitor compared with 26% of parents using scales</li> </ol>	<p>In the immediate post-perinatal period, the monitor is accepted readily and gives confidence, later the parents become over-reliant on the equipment to monitor infant breathing</p>
30	<p>Hutton, Gupta, Gruber, Berndsen, DeWitt, Ollberding, Van Ginkel, Ammerman Randomized Trial of a Children's Book Versus Brochures for Safe Sleep Knowledge and Adherence in a High-Risk Population 2017, U.S.</p>	<p>parental education</p>	<p>A randomized control trial involving 270 low SES mother/infant pairs at risk for negative parenting and child health outcomes enrolled in a home visiting program. Each mother received safe sleep teaching and assessment at several infant week markers utilizing a specially designed children's book or brochure.</p>	<ol style="list-style-type: none"> <li>1. Safe sleep knowledge increased across all time points with no overall group difference</li> <li>2. Odds of bed sharing were higher and exclusive crib use lower with brochure group</li> <li>3. Mothers and home visitors reported similar usefulness, mothers in the book group reported more book sharing with babies</li> </ol>	<p>The book and brochure were equally effective in conveying aggregate safe sleep knowledge in low SES mothers, adherence to exclusive crib use and avoiding bedsharing; bedsharing greater in book group</p>

**Table 1 Continued**

31	Baddock, Tipene-Leach, Williams, Tangiora, Jones, Iosua, Macleod, Taylor Wahakura Versus Bassinet for Safe Infant Sleep: A Randomized Trial 2017, New Zealand	sleeping space device	200 Maori pregnant women completed a baseline questionnaire and were randomized to receive a wahakura (small flexible bassinet) or bassinet for infant sleeping. Infants were followed up with at 1, 3, 6 months and monitored with infrared video to analyze infant head covering, breast-feeding, bedsharing, and maternal sleep	<ol style="list-style-type: none"> <li>1. The questionnaires showed no group differences at 1, 3, and 6 months in infant-adult bedsharing</li> <li>2. The wahakura group reported twice the level of full breastfeeding as the bassinet group at 6 months</li> <li>3. Maternal sleep and fatigue were not significantly different between groups, and video identified no increase in head covering, prone/side sleep position, or bedsharing in the wahakura group</li> </ol>	There were no significant differences in infant risk behaviors in wahakuras compared with bassinets, although there were other advantages, including an increase in sustained breast feeding. This suggests wahakura are relatively safe and can be promoted as an alternative to infant-adult bedsharing.
32	Moon, Matthews, Joyner, Oden, He, McCarter Health Messaging and African-American Infant Sleep Location: A Randomized Controlled Trial 2017, U.S.	parental education	637 African American mothers of infants were randomized into a control group, receiving standard AAP safe sleep practices messages, or an intervention group receiving enhanced safe sleep messages, including avoidance of bed sharing. Mothers completed interviews at 2-3 weeks, 2-3 months, and 5-6 months after infant birth	<ol style="list-style-type: none"> <li>1. Bedsharing increased slightly with infant age</li> <li>2. The receipt of enhanced messages did not impact sleep location</li> <li>3. Maternal belief that bedsharing increased risk of SIDS or suffocation declined over 6 months, didn't differ by group assignment</li> </ol>	African-American mothers who received an enhanced message about SIDS risk reduction and suffocation prevention were no less likely to bedshare with their infants

**Table 1 Continued**

33		healthcare staff education parental education	An intervention study with a historical control conducted at 2 hospitals including 550 newborns. Hospital staff members were trained to administer safe sleep information to parents through lessons, written materials, and crib stickers. Parents were surveyed by telephone	<ol style="list-style-type: none"> <li>1. 35% increase in the supine sleeping position</li> <li>2. Exclusive breastfeeding increased by 11.3%. Co-sleeping decreased from 31% to 18%</li> <li>4. No difference was observed in relation to bedroom sharing, living with tobacco users, or pacifier use at 60 days of infant life</li> </ol>	The educational intervention was useful to improve adherence to the recommendations on safe sleep at 60 days of life; using the supine sleep position and breastfeeding improved and the rate of co-sleeping decreased
34	Kiechl-Kohlendorfer, Peglow, Kiechl, Oberaigner, Sperl Epidemiology of sudden infant death syndrome (SIDS) in the Tyrol before and after an intervention campaign 2001, Austria	public health campaign	Parents of infants were interviewed after a country-wide campaign focusing on the modifiable risk behaviors of SIDS, disseminated through newspapers, radio, TV, prenatal classes. Risk factors for SIDS before the campaign were assessed in a retrospective case control review of 28,361 infants	<ol style="list-style-type: none"> <li>1. Incidence of SIDS decreased from 1.83 deaths per 1,000 live births to 0.4 deaths immediately after the campaign and remained low</li> <li>2. Frequency of maternal smoking during pregnancy, prevalence of prone sleep position, and non-breastfeeding all declined</li> </ol>	The study documents the long-term efficacy of a low-cost intervention campaign by way of health education
35	Hauck, Tanabe, McMurry, Moon Evaluation of bedtime basics for babies; a national crib distribution program to reduce the risk of sleep-related sudden infant deaths 2015, U.S.	sleeping space device parental education	Bedtime Basics for Babies enrolled 3,033 high risk families (no crib in home, low income, 1 risk factor for SIDS), and provided them with cribs and safe sleep education pre or post-natally. Parents completed surveys before and after infant birth, 1-3 months after crib receipt	<ol style="list-style-type: none"> <li>1. Parental knowledge of infant sleep position from 76% to 94% after crib receipt</li> <li>2. Intended use of supine position went from 84% to 87% after intervention</li> <li>3. Postnatally 51% of infants reportedly slept in crib, went up to 90% after intervention</li> </ol>	Program was successful in changing knowledge and practices in the majority of high-risk participants with regards to placing the infant supine in crib to sleep. Crib distribution and safe sleep education positively influence knowledge and practices about safe sleep

**Table 1 Continued**

36		healthcare staff education parental education	All NICU nurses at a large tertiary care hospital required to complete education program on risk reduction, including crib cards, crib audits, and online modules. Upon discharge parents received a safe sleep DVD and completed a post-discharge telephone survey	<ol style="list-style-type: none"> <li>1. NICU compliance with supine sleeping position increased from 39% to 83%</li> <li>2. Provision of a firm sleeping surface increased from 5% to 96%</li> <li>3. The removal of soft objects from the bed improved from 45% to 75%</li> <li>4. According to the post discharge telephone survey, parental compliance with safe sleep practices increased from 23% to 82%</li> </ol>	Multifactorial interventions improved compliance with safe sleep practices in the NICU and at home
37	Sauseng, Kerbl, Thaller, Hanzer, Zotter Baby sleeping bag and conventional bedding conditions--comparative investigations by infrared thermography 2011, Austria	sleeping space device	15 infants recruited from subjects admitted to the hospital on occasion of a SIDS prevention program were monitored for body temperature after sleeping under a blanket and after sleeping in a baby sleeping bag	<ol style="list-style-type: none"> <li>1. Infant mean body surface temperature and core temperature did not show significant differences after sleeping in a baby sleeping bag when compared to infants sleeping under a conventional blanket</li> </ol>	Under controlled conditions core temperature and mean body surface temperature are comparable if using a baby sleeping bag or conventional bedding. However, under uncontrolled conditions of home sleeping, sleeping bags might provide a more constant temperature profile while conventional bedding may lead to variations in temperature



**Table 1 Continued**

38	<p>D'Halluin, Rouseey, Branger, Venisse, Pladys          Formative evaluation to improve prevention of sudden infant death syndrome (SIDS): a prospective study          2011, France</p>	parental education	<p>292 postpartum mothers were randomized to a test or control group in a prospective study, both groups received information package about prevention of SIDS before discharge, the test group filled out a SIDS questionnaire before receiving the package</p>	<p>1. After 3 months, the educational questionnaire scores were higher for mothers in the test group          2. Mothers in the test group had knowledge of SIDS risk factors, avoidance to overheating infants, and risks of bedsharing</p>	<p>Formative evaluation using and educational questionnaire could improve maternal awareness on SIDS risk factors and their compliance with recommendations about SIDS prevention</p>
39	<p>Issler, Marostica, Giugliani          Infant sleep position: a randomized clinical trial of an educational intervention in the maternity ward in Porto Alegre, Brazil          2009, Brazil</p>	parental education	<p>228 mother-infant pairs were assigned to an intervention or control group in the hospital. Mothers in the intervention group received individual orientation sessions with oral explanations about the importance of supine sleep position, and home visits by trained medical students at 3 month intervals after birth</p>	<p>1. 42.9% of mothers in the intervention group put infants to sleep in the supine position at 3 months compared with 24% of mothers in the control group          2. The hospital intervention was the only variable that influenced maternal practices with respect to infant sleeping position</p>	<p>An individual educational session in the maternity ward about infant sleep position significantly increased the prevalence of supine position for sleeping in the infant's third month. However, the intervention was not sufficient to guarantee that most mothers would put their infants to sleep in the recommended position</p>

**Table 1 Continued**

40	<p>Sperhake, Zimmerman, Puschel            Current recommendations on infants' sleeping positions are being followed--initial results of a population-based sentinel study on risk factors for SIDS, 1996-2006, in Hamburg, Germany            2009, Germany</p>	public health campaign	<p>Regional and local campaigns discouraging prone sleep were instituted throughout the mid-1990s, parents were given questionnaires regarding infant sleeping position, bedding habits, feeding habit, and parental smoking in 1996, 1998, 2001, and 2006</p>	<ol style="list-style-type: none"> <li>1. From 1996 to 1997, the SIDS rate in Hamburg fell from 0.9 deaths per 1,000 live births to 0.1 deaths</li> <li>2. The prevalence of infants sleeping prone decline from 8.1% in 1996 to 3.5% in 2006</li> <li>3. The prevalence of infants sleeping on their side fell from 55.3% in 1998 to 10.6% in 2006</li> </ol>	<p>The sentinel setting is suitable for gathering risk-related data on SIDS. Although no nationwide back to sleep campaign has been initiated, local campaigns have proved successful in reducing prone sleeping for infants. The substantial reduction of side sleeping within a short time span going along with a reduced SIDS rate is an indicator of the effectiveness of prevention activities on a local basis.</p>
41	<p>Price, Hillman, Gardner, Schenk, Warren            Changing hospital newborn nursery practice: results from a statewide "Back to Sleep" nurses training program            2008, U.S.</p>	healthcare staff education	<p>Nurses in Missouri hospitals were trained using 2 distinct training formats, each group responded to pre and post tests and a follow up 3 month survey regarding knowledge, beliefs, and current infant care behaviors. The first group received training from an agency that provided ongoing in hospital education, and the second group participated in individual computer-based training</p>	<ol style="list-style-type: none"> <li>1. Nurses who participated in the training reported significant improvements in knowledge and back to sleep adherence beliefs</li> <li>2. Over 98% of participants intended to place infants only on their backs following training</li> <li>3. Knowledge, attitudes, and practice intentions improved across both training formats</li> <li>4. At follow up, 63% of respondents reported using supine only sleep position</li> </ol>	<p>Findings from this nursing-specific "Back to Sleep" curriculum demonstrate that it has a promising effect on risk-reduction adherence in hospital settings where parent observations of safe sleep behavior first occur.</p>

**Table 1 Continued**

42	<p>Markowitz The effectiveness of cigarette regulations in reducing cases of Sudden Infant Death Syndrome 2008, U.S.</p>	other	<p>Examined the direct effects of cigarette prices, taxes, and clean indoor air laws in explaining the changes in the incidence of SIDS over time</p>	<p>1. Higher cigarette prices and taxes are associated with reductions in SIDS cases</p>	<p>Stronger restrictions on smoking in workplaces, restaurants, and childcare centers are additional measures effective in reducing SIDS</p>
43	<p>Burd, Peterson, Face, Face, Shervold, Klug Efficacy of a SIDS Risk Factor Education Methodology at a Native American and Caucasian Site 2007, U.S.</p>	parental education	<p>341 women at 2 community sites were given pre and post intervention tests focusing on 9 risk factors including no alcohol/smoking, crib without bedding etc. The intervention included education by hospital nurses at discharge, home visiting staff after birth, and the provision of a baby blanket and a summary handout</p>	<p>1. Pretests found knowledge deficits about SIDS risk factors in both groups 2. Pre and posttests changes for 9 risk factors ranged from 5% to 74% 3. Participants from both groups demonstrated nearly equivalent rates of learning for all 9 risk concepts</p>	<p>Study demonstrated the efficacy of a brief intervention program that was effective in increasing parental knowledge of the risk factors targeted in the study in both settings</p>
44	<p>Barnes-Josiah, Eureka, Huffman, Heusinkvelt, Severe-Oforah, Schwalberg Effect of "this side up" T-shirts on infant sleep position 2007, U.S.</p>	<p>public health campaign parental education</p>	<p>A random sample of 831 mothers received and returned a questionnaire on 7 key items upon the receipt of a t-shirt and SIDS risk reduction materials at a birthing hospital</p>	<p>1. 64% of respondents reported the infant slept on their back, percentage was less for African American and Hispanic infants 2. White race and receipt of a SIDS brochure were positive predictors of back sleep</p>	<p>Receiving an infant t-shirt was not related to how mothers placed their infants to sleep. Additional research is needed on effective methods of delivering targeted counseling and promoting safe sleep practices, particularly among racial and ethnic subgroups</p>

**Table 1 Continued**

45		other	<p>Evaluated the effectiveness of the 2 years of the Back to Sleep campaign by examining regulations available for licensed child care centers and family child care homes in 50 states &amp; Washington D.C. for specific regulations pertaining to SIDS risk reduction training for childcare providers, including infant sleep position, crib safety, etc.</p>	<ol style="list-style-type: none"> <li>1. Since 2003 when the campaign began, 60 of 101 state regulations for childcare centers or FCCCHs have been revised</li> <li>2. More than half of rewritten regulations mandate non-prone sleeping and restrictions on soft bedding crib</li> <li>3. Of 101 existing state regulations, only 49 require that infants sleep non-prone, 18 mandate SIDS training for childcare providers, 81 have more than 1 crib safety standard, 43 restrict soft bedding in crib</li> </ol>	<p>The initial 2 years of the Healthy Child Care America Back to Sleep campaign have been successful in promoting safe infant sleep regulations. Efforts must continue so that safe sleep regulations exist in all jurisdictions.</p>
46	<p>Pickett, Luo, Lauderdale Widening social inequalities in risk for sudden infant death syndrome 2005, U.S.</p>	public health campaign	<p>A population-based cohort study studying 2 periods, before and after the Back to Sleep campaign, using U.S. Linked Birth/Infant Death data sets. The case group was infants who died of SIDS in infancy, the control group was a 10% random sample of infants who lived to 1 year old and infants who died of other causes, social class was measured by mother's education level</p>	<ol style="list-style-type: none"> <li>1. No evidence that inequalities in SIDS were reduced after BTS campaign</li> <li>2. Odds ratios for SIDS associated with lower social class increased between 1989-1991 and 1996-1998</li> <li>3. Race disparity in SIDS increased after BTS campaign</li> </ol>	<p>The introduction of an inexpensive, easy, public health intervention has not reduced social inequalities in SIDS; in fact, the gap has widened. Although the risk of SIDS has been reduced for all social class groups, women who are more educated have experienced the greatest decline</p>

**Table 1 Continued**

47	Inbar, Meibar, Shehada, Irena, Rubin, Rishpon "Back to sleep": parents compliance with the recommendation on the most appropriate sleeping position of infants, Haifa District, Israel, 2001 2005, Israel	public health campaign	1,912 parents of infants who visited a primary health center during the study week answered self-administered questionnaires about a public health campaign recommending placing infants on their backs to sleep	<ol style="list-style-type: none"> <li>1. 15.6% of infants &lt;1 were placed to sleep in prone position</li> <li>2. 12.4% of infants &lt;3 months placed prone</li> <li>3. 17.6% of infants 3-6 months old placed prone</li> <li>4. Israeli-born Jewish mothers were more likely to place babies prone than Israeli-born Arab mothers or mothers born in former Soviet Union who had immigrated to Israel after 1990</li> </ol>	At-risk behaviors are usually associated with minority and immigrant populations. Culture specific and other possible reasons for this
48	Malloy, Freeman Age at death, season, and day of death as indicators of the effect of the back to sleep program on sudden infant death syndrome in the United States, 1992-1999 2004, U.S.	public health campaign	Determined if significant changes in SIDS rates have occurred in age at death (0-27 days vs 1-6 months vs 7-11 months), season of death, and weekday of death since the implementation of the recommendations for supine positioning of infants for sleep.	<ol style="list-style-type: none"> <li>1. Average annual decrease in SIDS was 6.6% for 0 to 27 days, 9% for 1-6 months, 6.1% for 7-11 months</li> <li>2. Average decline in seasonal rates from winter to summer was 11.2% per season</li> <li>3. Diminishing rate of seasonal variation</li> <li>4. No significant interaction between year of death and weekday of death, no change in relationship since implementation of supine sleeping recommendation</li> </ol>	These data provide insights into the effect of the supine sleep recommendations on SIDS. The reduction in seasonal variation of SIDS suggests advantages of supine sleeping in colder seasons

**Table 1 Continued**

49	Gibson, Dembofsky, Rubin, Greenspan Infant sleep position practices 2 years into the "back to sleep" campaign 2000, U.S.	public health campaign	410 parents of infants answered a questionnaire in Philadelphia clinics and private pediatric offices on sleep position practices. Results were compared with reported rates in similar populations before the back to sleep campaign	<ol style="list-style-type: none"> <li>1. 72% of infants slept non-prone compared to 31.8% in 1993 and 59.1% in 1994</li> <li>2. Breastfeeding rate was 31%, maternal smoking 17%, co-sleeping 46%</li> <li>3. African American infants receiving care at clinic and infants &gt;3 months old are less likely to be placed non-prone</li> </ol>	Non-prone sleeping continues to increase since the initiation of the "Back to Sleep" campaign. Disparity between some demographic groups persists. An excessive number of African American families and clinic families still choose a prone sleep position.
50	Srivatsa, Eden, Mir Infant sleep position and SIDS: a hospital-based interventional study 1999, U.S.	healthcare staff education parental education	A cross-sectional study involving two samples of 250 mothers of infants attending outpatient clinics in New Year filled out questionnaires regarding infant care practices. Hospital intervention included specific back to sleep policies in the nursey, training of infant care personnel, back to sleep videos played in well baby nursery, discharge pamphlets for parents	<ol style="list-style-type: none"> <li>1. Proportion of infants sleeping prone reduced significantly from 27% to 18%</li> <li>2. Some mothers worried about choking; older mothers responded with reduction in prone placement</li> <li>3. SIDS awareness was 79.6% before intervention and 82.4% after intervention</li> </ol>	The Back to Sleep campaign was effective in our hospital setting. Data indicate the need for special targeting of young, unmarried, and non-breast-feeding mothers. Fear of choking remains an important deterrent to proper infant sleep positioning.

**Table 1 Continued**

51	<p>Dwyer, Ponsonby, Blizzard, Newman, Cochrane</p> <p>The contribution of changes in the prevalence of prone sleeping position to the decline in sudden infant death syndrome in Tasmania 1995, Australia</p>	public health campaign	5,543 high risk infants participated in a cohort analysis comparison of the whole population incidence of SIDS before and after intervention to reduce prevalence of prone sleeping	<ol style="list-style-type: none"> <li>1. SIDS rate decreased from 3.8 deaths to 1.5 deaths per 1,000 live births</li> <li>2. Prevalence of usual prone sleeping at 1 month of age was 29.9% and 4.3% in 2 cohorts</li> <li>3. 70% of SIDS rate reduction in cohort could be accounted for by the decreased prevalence of prone sleeping position</li> </ol>	The major contributing factor to the recent SIDS rate decline in Tasmania has been the reduction in the proportion of infants usually sleeping prone.
52	<p>Ponsonby, Dwyer, Kasl, Cochrane, Newman</p> <p>An assessment of the impact of public health activities to reduce the prevalence of the prone sleeping position during infancy: the Tasmanian Cohort Study 1994, Australia</p>	public health campaign	5,403 parents of infants participated in hospital education and home interviews to decrease the prevalence of prone sleeping position among cohort infants	<ol style="list-style-type: none"> <li>1. Proportion of infants usually sleeping prone declined from 29.9% in cohort prior to public health campaign to 5.4% in the post campaign</li> <li>2. Nonawareness positively associated with maternal smoking, maternal education, paternal unemployment</li> </ol>	Public health activities to reduce prevalence of prone sleeping position have had significant impact, with dramatic reduction in proportion of cohort infants usually sleeping prone
53	<p>Gibson, Fleming, Fleming, Culhane, Hauck, Janiero, Spitzer</p> <p>Sudden infant death syndrome rates subsequent to the American Academy of Pediatrics supine sleep position 1998, U.S.</p>	public health campaign	Box and Tiao time-series intervention methodology was used to examine the effect of the AAP recommendation on SIDS rates. Sudden Infant Death Syndrome mortality data from Philadelphia and Chicago were examined separately for white and nonwhite populations over 32 quarters.	<ol style="list-style-type: none"> <li>1. SIDS rates dropped significantly according to abrupt effect from intervention</li> <li>2. Effect gradually disappearing in Philadelphia but permanent in Chicago</li> </ol>	There was abrupt adoption of the recommendation, but some evidence was found that the effect is temporary. The demonstrated methodology provides a powerful way to test naturally occurring interventions from quasi-experimental designs to test the impact of policy guidelines.

**Table 1 Continued**

54	<p>Finau, Finau, Fuamantu, Tukuitonga          SIDS or Sitis: plight and response of Pacificans in New Zealand (Aotearoa)          2003, New Zealand</p>	public health campaign	<p>A national SIDS prevention program was found not to be effective for Pacificans, 9 parents of Pacific SIDS babies were interviewed, their responses resulted in a SIDS prevention program tailored to Pacific parents</p>	<p>1. The development of a Pacific SIDS Prevention Program, structure and strategy was culturally and ethnically appropriate, a feature that was lacking in previous national SIDS program</p>	<p>The importance and initiation of community-based strategies is central to the Pacificans' response to Sitis and its determinants. The success of this approach provides a model for intervention and health promotion, at least, among Pacificans globally</p>
55	<p>de Chalain          The Safe-T-Sleep device: safety and efficacy in maintaining infant sleeping position          2003, New Zealand</p>	sleeping space device	<p>A prospective, hospital-based trial to assess the safety and efficacy of the Safe-T-Sleep device, a form of infant sleep ware, that allows semi-supine positioning, reduces PWS, while not increasing risk of SIDS. The device was trialed on 31 babies spending at least 1 night in the hospital, totaling 396 hours of observation</p>	<p>1. Infants maintained selected body position in 94% of recorded observations and head position in 87%          2. No significant adverse events or complications associated with use of device</p>	<p>The device appears to be safe and effective. It is now being advocated in affiliated clinic as an aid to active counter-positioning strategies to passively correct incipient or established positional plagiocephaly in younger babies.</p>



## Appendix C Public Health Campaign Summary

**Table 2. Public Health Campaign Summary**

Name of Intervention, Year Implemented	Study ID	Title	Year	Country or Region	Outcome Measured	Results
SIDS Campaign, 1991-92						
	52	An assessment of the impact of public health activities to reduce the prevalence of the prone sleeping position during infancy: the Tasmanian Cohort Study	1994	Australia	SIDS rate prone sleeping	<ol style="list-style-type: none"> <li>1. Proportion of infants usually sleeping prone declined from 29.9% in cohort prior to public health campaign to 5.4% in the post campaign</li> <li>2. Nonawareness positively associated with maternal smoking, maternal education, paternal unemployment</li> </ol>
	28	Correlates of prone infant sleeping position by period of birth	1994	Tasmania (Australia)	prone sleeping	<ol style="list-style-type: none"> <li>1. The usual prone sleeping position was more closely associated with the following factors after the intervention; teenage motherhood, low maternal education, paternal unemployment, unmarried motherhood, non-specialist antenatal care, poor smoking hygiene, bottle feeding</li> </ol>

**Table 2 Continued**

	5	Mothers' knowledge of the risk factors and anxiety about SIDS	1995	Australia	mothers' knowledge and anxiety	<ol style="list-style-type: none"> <li>1. the recall rate increased as the campaign progressed</li> <li>2. receiving the campaign pamphlet was associated with an increased recall of risk factors</li> </ol>
	51	The contribution of changes in the prevalence of prone sleeping position to the decline in sudden infant death syndrome in Tasmania	1995	Australia	infant sleep position	<ol style="list-style-type: none"> <li>1. SIDS rate decreased from 3.8 deaths to 1.5 deaths per 1,000 live births</li> <li>2. Prevalence of usual prone sleeping at 1 month of age was 29.9% and 4.3% in 2 cohorts</li> <li>3. 70% of SIDS rate reduction in cohort could be accounted for by the decreased prevalence of prone sleeping position</li> </ol>
SIDS Campaign, 1994						
	34	Epidemiology of sudden infant death syndrome (SIDS) in the Tyrol before and after an intervention campaign	2001	Austria	SIDS incidence epidemiology of SIDS	<ol style="list-style-type: none"> <li>1. Incidence of SIDS decreased from 1.83 deaths per 1,000 live births to 0.4 deaths immediately after the campaign and remained low</li> <li>2. Frequency of maternal smoking during pregnancy, prevalence of prone sleep position, and non-breastfeeding all declined</li> </ol>
N/A *only local and regional campaigns						

**Table 2 Continued**

	26	Prevalence and Determinants of Prone Sleeping Position in Infants: Results from Two Cross-Sectional Studies on Risk Factors for SIDS in Germany	1999	Germany	prone sleeping	1. Prevalence of prone sleeping decreased from 37.6% to 8.7% in the German population and from 44.1% to 32% in the Turkish immigrant population
	40	Current recommendations on infants' sleeping positions are being followed--initial results of a population-based sentinel study on risk factors for SIDS, 1996-2006, in Hamburg, Germany	2009	Germany	SIDS rate prone sleeping side sleeping	1. From 1996 to 1997, the SIDS rate in Hamburg fell from 0.9 deaths per 1,000 live births to 0.1 deaths 2. The prevalence of infants sleeping prone decline from 8.1% in 1996 to 3.5% in 2006 3. The prevalence of infants sleeping on their side fell from 55.3% in 1998 to 10.6% in 2006
SIDS campaign led by the Irish Sudden Infant Death Association (ISIDA) and the Department of Health, 1992, 1995						

**Table 2 Continued**

	12	Reduce the risk of cot death guidelines: effect of a revised intervention programme	1999	Ireland	health literature access SIDS risk factors	<ol style="list-style-type: none"> <li>1. in both sets of interviews the media was the most frequent source of information for parents</li> <li>2. medical sources and public health nurses ranked second in terms of source of information</li> <li>3. after the pamphlet update more parents reported putting their babies to sleep on their backs, but they used heat more frequently</li> <li>4. the updated pamphlet had less effect on further changing parents' practices, but the overall effect of the education program was successful in yielding a low percentage of babies sleeping prone</li> </ol>
	15	Sudden infant death syndrome--are parents getting the message?	2000	Ireland	sleeping position SIDS risk factors	<ol style="list-style-type: none"> <li>1. 41% of infants still placed on side to sleep, first time parents more likely to place infants on back</li> <li>2. over 60% of infants were exposed to one or more adults smoking in the home despite parental knowledge of association with SIDS</li> <li>3. 68% of infants were overwrapped at night</li> <li>4. 13% of infants regularly co-slept with parents</li> </ol>
Israel Ministry of Health Supine Sleeping Recommendation, 1993						

**Table 2 Continued**

	47	"Back to sleep": parents compliance with the recommendation on the most appropriate sleep position of infants, Haifa District, Israel, 200	2001	Israel	prone sleeping	<ol style="list-style-type: none"> <li>1. 15.6% of infants &lt;1 were placed to sleep in prone position</li> <li>2. 12.4% of infants &lt;3 months placed prone</li> <li>3. 17.6% of infants 3-6 months old placed prone</li> <li>4. Israeli-born Jewish mothers were more likely to place babies prone than Israeli-born Arab mothers or mothers born in former Soviet Union who had immigrated to Israel after 1990</li> </ol>
New Zealand Cot Death Prevention Program, 1991						
	13	Evaluation of the cot death prevention programme in South Auckland	1993	New Zealand	prone sleeping SIDS risk factors	<p>the following percentage of mothers knew that these were risk factors for cot death</p> <p>prone sleeping position: 95.5%</p> <p>maternal smoking: 89.4%</p> <p>lack of breastfeeding: 63.1%</p> <p>infant sharing bed with another person: 68%</p>
	54	SIDS or Sitisi: plight and response of Pacificans in New Zealand (Aotearoa)	2003	New Zealand	creation of a SIDS prevention program	<ol style="list-style-type: none"> <li>1. The development of a Pacific SIDS Prevention Program, structure and strategy was culturally and ethnically appropriate, a feature that was lacking in previous national SIDS program</li> </ol>
SIDS Campaign, 1990						
	19	Sleeping position and sudden infant death syndrome (SIDS): an intervention programme to avoid prone sleeping	1995	Norway	SIDS rate prone sleeping	<ol style="list-style-type: none"> <li>1. 64% of infants were placed prone before the campaign versus 8% after</li> <li>2. the rate of SIDS decreased from 3.5 to 1.6 deaths per 1,00 live births</li> </ol>

**Table 2 Continued**

	21	Abandoning prone sleeping: effect on the risk of sudden infant death syndrome	1997	Norway	SIDS rate prone sleeping	<ol style="list-style-type: none"> <li>1. SIDS rate declined from 3.5 deaths per 1,000 live births to 0.3 deaths as prone sleeping as the preferred sleep position dropped from 64% to 8%</li> <li>2. of the refence infants, 1.4% were usually placed prone to sleep, nearly half were placed supine</li> <li>3. of the 5 SIDS victims, 1 usually slept prone and 3 were placed prone for their last sleep</li> </ol>
SIDS Campaigns Norway, 1990 Denmark, 1991 Sweden, 1992, 1994						
	17	The decline in the incidence of SIDS in Scandinavia and its relation to risk-intervention campaigns	1997	Scandinavia	SIDS incidence prone sleeping	<ol style="list-style-type: none"> <li>1. after the campaign, the SIDS incidence decreased from 2.3 deaths per 1,000 live births in Norway, 1.6 deaths in Denmark, and 1.0 deaths in Sweden to 0.6 deaths per 1,000 live births or fewer in all the Scandinavian countries</li> <li>2. Decline in prone sleeping position and post neonatal mortality in all 3 countries</li> </ol>
Back to Sleep, 1991						
	8	Prevention of Unexpected Infant Death: Evaluation of the First Seven Years of the Sheffield Intervention Program	1983	U.K.	evaluate a scoring system to identify high risk infants	<ol style="list-style-type: none"> <li>1. possible preventable deaths fell from 5.2 death to 1.9 deaths per 1,000 live births.</li> <li>2. the reduction in mortality was attributed directly to the effect of increase home visiting of high-risk infants</li> </ol>
	14	SIDS: risk reduction measures	1994	U.K.	prone sleeping SIDS risk factors	<ol style="list-style-type: none"> <li>1. Prevalence of prone sleeping fell from 60% to 28%</li> <li>2. The relative importance of</li> </ol>

**Table 2 Continued**

						smoking and bottle feeding increased 3. The SIDS rate fell from 3.5 deaths per 1,000 live births to 1.7 deaths
	27	Evaluation of a government's campaign to reduce risk of cot death	1994	U.K.	prone sleeping	1. Infant sleeping position changed after the campaign; older babies were more likely to sleep on their backs 2. Quilts were used less often after the campaign, use increased with baby age
Back to Sleep, 1994 (now called Safe to Sleep)						
	6	Recommendations to avoid the prone sleeping position and recent statistics for sudden infant death syndrome in the united states	1994	United States	SIDS incidence evaluate effectiveness of media campaign	1. in the 8 months following the article, the incidence of SIDS fell by 52% in the highest county of readership 2. in the 12 months following the initial 8 months, the number of SIDS cases was reduced to half the previous annual average
	53	Sudden infant death syndrome rates subsequent to the American Academy of Pediatrics supine sleep position	1998	United States	prone sleeping	1. SIDS rates dropped significantly according to abrupt effect from intervention 2. Effect gradually disappearing in Philadelphia but permanent in Chicago
	49	Infant sleep position practices 2 years into the "back to sleep" campaign	2000	United States	prone sleeping SIDS risk factors	1. 72% of infants slept non-prone compared to 31.8% in 1993 and 59.1% in 1994 2. Breastfeeding rate was 31%, maternal smoking 17%, co-sleeping 46% 3. African American infants receiving care at clinic and infants

**Table 2 Continued**

						>3 months old are less likely to be placed non-prone
	48	Age at death, season, and day of death as indicators of the effect of the back to sleep program on sudden infant death syndrome in the United States, 1992-1999	2004	United States	SIDS incidence prone sleeping seasonal variations	<ol style="list-style-type: none"> <li>1. Average annual decrease in SIDS was 6.6% for 0 to 27 days, 9% for 1-6 months, 6.1% for 7-11 months</li> <li>2. Average decline in seasonal rates from winter to summer was 11.2% per season</li> <li>3. Diminishing rate of seasonal variation</li> <li>4. No significant interaction between year of death and weekday of death, no change in relationship since implementation of supine sleeping recommendation</li> </ol>
	44	Effect of "this side up" T-shirts on infant sleep position	2004	United States	effect of receiving a targeted message t-shirt prone sleeping	<ol style="list-style-type: none"> <li>1. 64% of respondents reported the infant slept on their back, percentage was less for African American and Hispanic infants</li> <li>2. White race and receipt of a SIDS brochure were positive predictors of back sleep</li> </ol>
	46	Widening social inequalities in risk for sudden infant death syndrome	2005	United States	social class inequalities in SIDS	<ol style="list-style-type: none"> <li>1. No evidence that inequalities in SIDS were reduced after BTS campaign</li> <li>2. Odds ratios for SIDS associated with lower social class increased between 1989-1991 and 1996-1998</li> <li>3. Race disparity in SIDS increased after BTS campaign</li> </ol>



**Table 2 Continued**

	11	A Hospital-Based Initiative to Reduce Post discharge Sudden Unexpected Infant Deaths	2018	United States	SIDS rate evaluate risk reduction project	<ul style="list-style-type: none"> <li>1. average death rate fell from 1.08 deaths per 1,000 live births to 0.48 deaths</li> <li>2. average number of deaths between deliveries increased from 1 in every 584 deliveries to 1 in every 1,420 deliveries</li> </ul>
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## Appendix D Included Studies by Country

**Table 3. Included Studies by Country**

<b>Country or Region</b>	<b>Number of Studies</b>	<b>Study ID(s)</b>
Argentina	1	33
Australia	5	3, 5, 28, 51, 52,
Austria	3	16, 34, 37
Brazil	1	39
France	1	38
Germany	2	26, 40
Ireland	2	12, 15
Israel	1	47
New Zealand	5	1, 13, 31, 54, 55
Norway	2	19, 21
Scandinavia	1	17
U.K.	5	8, 14, 18, 27, 29
United States	26	2, 4, 6, 7, 9, 10, 11, 20, 22, 23, 24, 25, 30, 32, 35, 36, 41, 42, 43, 44, 45, 46, 48, 49, 50, 53

## Appendix E Educational Poem Given to New Mothers

A simple secret I want you to keep;  
Put your baby on his back to sleep.  
On her stomach place the baby never;  
In a cot or crib, to sleep wherever.  
Crib death or SIDS call it what you may;  
Is very tragic, causing horror and dismay.  
It is related to the way the babies sleep;  
And can be reduced by back to sleep.  
What about choking? You surely do wonder;  
A thought about which many do ponder.  
Be rest assured and please pay attention;  
It just does not happen by changing position.  
Back to sleep is the safest way to go;  
Until the cause of SIDS surely we'll know.  
A simple secret I want you to keep;  
Put your baby on her back to sleep

(Srivatsa et al., 1999)

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