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The Institution of a Standardized Investigation Protocol for Sudden Infant Death in the Eastern Metropole, Cape Town, South Africa^{*,†,‡}

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Abstract

The rate for the sudden infant death syndrome (SIDS) in Cape Town, South Africa, is estimated to be among the highest in the world (3.41/1000 live births). In several of these areas, including those of extreme poverty, only sporadic, nonstandardized infant autopsy, and death scene investigation (DSI) occurred. In this report, we detail a feasibility project comprising 18 autopsied infants with sudden and unexpected death whose causes of death were adjudicated according to the 1991 NICHD definitions (SIDS, $n = 7$; known cause of death, $n = 7$; and unclassified, $n = 4$). We

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instituted a standardized autopsy and infant DSI through a collaborative effort of local forensic pathology officers and clinical providers. The high standard of forensic investigation met international standards, identified preventable disease, and allowed for incorporation of research. We conclude that an effective infant autopsy and DSI protocol can be established in areas with both high sudden unexpected infant death, and elsewhere. (SUID)/SIDS risk and infrastructure challenges.

Keywords

forensic science; infant death scene investigation; sudden infant death syndrome; bed sharing; prematurity; infant mortality; forensic pathology

Sudden Unexpected Infant Death (SUID), including those sudden deaths that are unexplained, is a major global health problem with the highest rates among the socioeconomically disadvantaged (1–6). The sudden infant death syndrome (SIDS) accounts for 50–80% of cases of Sudden Unexpected Death in Infants (SUDI) / Sudden Unexpected Infant Death (SUID (7); it is defined as the sudden death of an infant less than a year old, the cause of which remains unexplained after a review of the clinical history, complete autopsy, and death scene investigation (DSI) (8). The rate for SIDS in Cape Town, South Africa, is estimated to be among the highest in the world (3.41/1000 live births) (9). Investigation into SIDS/SUID, as well as the collection of accurate demise data, is complicated by lack of standardization of infant death investigation and autopsy performance, particularly on an international scale (10,11). These factors may also hamper potential intervention programs in these communities that are already challenged by socioeconomic and infrastructure issues. In 2005 and 2006, two sentinel events occurred to address SUID deaths within the Eastern Metropole region of the greater Cape Town Metropole. First was the initiation of an international research investigation of SIDS by the Prenatal Alcohol in SIDS and Stillbirth (PASS) Network in high-risk communities, including this area, called the Safe Passage Study in 2007 (12). This study focuses mainly on two high-risk populations for SIDS in which 12,000 maternal/fetal dyads are enrolled early in the pregnancy, with 7000 women of mixed ancestry in selected areas of the Eastern Metropole of Cape Town, and 5000 women in the Northern Plains of the USA, including American Indian and Caucasian populations (12). The offspring are followed for one postnatal year, the period of risk for SIDS.

The second key event was the establishment of a National Forensic Pathology Service and the subsequent transfer of the medico-legal mortuaries in South Africa from the South African Police Service to the National Forensic Pathology Services (FPS) under the South African Department of Health in April 2006. Although this change allowed the focus of forensic investigations to include health intervention, the FPS was faced with the monumental task of reappraisal and development of the service. A key focus of the FPS was the DSI related to sudden death in children and adults, although resources for implementation and training of these goals remained a challenge to the FPS. The synergy between consented research protocols in sudden death in infants and the coincident transformation of the FPS in South Africa resulted in the unique opportunity to utilize a standardized autopsy protocol and DSI in developing the procedures specifically for scene

investigation for sudden infant deaths falling under the jurisdiction of the Western Cape FPS (WCFPS).

We report here the outcome of a pilot study of 18 sudden and unexpected infant deaths in this area to assess the feasibility of implementing forensic investigation to international standards of SIDS/SUID cases by the new Forensic Pathology Services, while offering the opportunity to both families and forensic practitioners to participate in research studies to address SIDS/SUID. We report the establishment of the investigative protocols in the WCFPS because our experience and protocols may prove of immediate value to other healthcare providers faced with similar issues and challenges with SIDS, particularly in socioeconomically disadvantaged populations elsewhere in the world.

Materials and Methods

Case Population

The Eastern Metropole region of Cape Town, Western Cape, South Africa, is home to a large population of mixed race ancestry where extreme poverty is common (13), yet a vibrant and proud cultural heritage has developed. Approximately 1 million people live in this roughly 500-km² region of Cape Town, sometimes referred to as the “Cape Flats.” Unemployment is high and provision of basic needs of food, shelter, and health care is challenging (13). Within some informal settlement areas, one- or two-room dwellings, self-constructed from scrap material, may house extended family groups of 10 or more people. Cosleeping is nearly universal both from a cultural context and the basic necessity of several individuals, both adults and children, sharing limited sleeping areas. The partnership between the study and WCFPS developed as the sampling area lies within the forensic service area of the new WCFPS. The study population therefore was derived mainly from selected areas of the Eastern Metropole. When demises were identified as possible study cases, forensic pathologists and forensic pathology officers of the WCFPS, as well as the principal investigator and clinical coordinators of the Safe Passage Study, were notified. This notification process resulted in scene investigation by the responsible personnel, as well as training of forensic pathology officers. It also resulted in the approach of the parents by Safe Passage Study personnel for consent for the research component of the study and a DSI, often at a later stage of the investigation (after removal of the body by WCFPS).

Inclusion Criteria of Infant Demises

Research-consented SUID cases were collected under the auspices of the 16-month feasibility study (Phase 1: August 2005–July 2007). Although the definition of SUID and SIDS includes all sudden and unexpected deaths between birth and 12 months of age (7–9), we included in this feasibility study only cases that were discharged from the hospital postpartum and died at home or in a related (nonhospital) environment. Inclusion criteria also included maternal age at 18 years or older at consent and residence in the municipal suburbs of Bishop Lavis or Elsies River. The study cases were not the only cases of SUDI admitted to the Tygerberg Medico-Legal Laboratory for the time period of the feasibility study, and this may introduce bias in terms of the profile of the cases investigated. It was felt, however, that the aim of the study—the investigation into the feasibility of full SUDI

investigation—was not negatively influenced by the research-consented selection of the cases.

Death Scene Investigation (DSI)

The standardized DSI form published by the Centers for Disease Control (CDC), Atlanta, GA (14), was selected for use after intensive review by and approval of the investigators of the Safe Passage Study, which includes forensic pathologists from all study locations. Among the information obtained in this protocol were postnatal age, gestational age, individual who found the infant, relationship of the infant death to a sleep period, time infant was found, position found, cosleeping information (yes/no, number of cosleepers, age/size/relationship of cosleepers, typical sleeping arrangements), and bedding environment (soft, mattresses, coverings, pillows, wedging). Forensic investigators also noted basic medical information about the infant, for example, number and place of well-baby visits, any medication, and illnesses of the infant. In the course of this feasibility study, modifications were made to the DSI to address local issues, as delineated below.

Training

Forensic pathologists and clinical investigators from the United States, who had extensive experience in the CDC SIDS/SUID protocols, conducted “Train the Trainer” workshops in CDC SUID protocols for forensic pathology officers (death investigators) from the WCFPS, clinical investigators from the Faculty of Medicine and Health Science (FMHS) of Stellenbosch University, and healthcare workers in obstetrics and pediatrics at the Bishop Lavis Community Health Centre and surrounding clinics. Although initially developed as part of a research protocol, the training was extended to achieve the developing WCFPS investigation goals. Throughout the 16-month feasibility study, the DSIs performed by WCFPS officers and research investigators in the Safe Passage Study were reviewed by international researchers for the research-consented cases, that is., the Pathology Committee.

Standardized Autopsy Protocol

The Pathology Committee of the Safe Passage Study developed a standardized autopsy protocol, accounting for local practices and feasibility. The committee included forensic and pediatric pathologists, pediatric neuropathologists, obstetricians, pediatricians, dysmorphologists, and geneticists. The protocol was based in part upon the California protocol for SUID (15), as well as those used locally. All autopsies included detailed external examination, histology of major organ systems, bacteriologic and viral cultures, HIV testing, and toxicology screen where indicated. Whole brain was not fixed, but standardized, and representative histology was taken at autopsy, which included orbitofrontal, posterior frontal lobe, hippocampus, basal ganglia, hypothalamus, occipital lobe, and brainstem. Due to financial constraints, metabolic and channelopathy screening was not undertaken, unless indicated by specific family histories or concerns raised in the autopsy, for example, fatty liver as potential marker of fatty oxidation disorder. The complete autopsies were performed by forensic pathologists of WCFPS, or by anatomical pathologists of the National Health Laboratory Service, Tygerberg Hospital and Stellenbosch University, at the discretion of the WCFPS pathologists, where autopsy was not mandated by South African law to be forensically investigated for sudden death or suspicion

of child abuse. If parental permission for research was given, additional tissue, blood, and Guthrie DNA cards were obtained at autopsy. University-based pathologists were available for assisting with research tissue procurement at the forensic autopsy. At the discretion of WCFPS pathologists, consultation with University pathologists was made at time of autopsy if gross findings were indicative of significant natural disease.

Adjudication of Cause of Death for the Study

All study pathologists reviewed the autopsy findings and microscopic slides. In conjunction with the entire PASS Pathology Committee, complete consensus on the classification of death in each case was obtained, applying the 1990 NICHD definitions (8). SIDS defined an unexplained death and represented a diagnosis of exclusion. A known/explained cause of death was established by autopsy and/or DSI. An unclassified (undetermined) category was applicable to infant deaths in which the cause could not be determined with certainty due to the equivocal nature of the autopsy findings and/or circumstances at the death scene.

Cause of Death for Nonresearch Purposes

The forensic pathologists, as legally mandated, made the medico- legal diagnosis and death notification in the usual fashion. These adjudications occurred prior to research review, with the exception of case 7 (Table 1) where consultation was obtained from University pathologists due to unexpected neoplastic findings at autopsy.

Ethics

The protocol of the study, including the informed consent forms in Afrikaans and English, was approved by the Health Research Ethics Committee of Stellenbosch University. Further approval was obtained from the Institutional Review Board of Boston Children's Hospital, MA, the Data Coordinating and Analysis Center (DM-STAT, Inc., Malden, MA), and the Western Cape Provincial Department of Health.

Results

Infant Demise Evaluation

The Safe Passage Study (Phase I or Pilot) received informed parental consent for the investigation of 20 SUID deaths in its catchment area during the 16- month pilot period. One case was excluded for study because the death occurred prior to discharge from the hospital, and a second case was excluded because the parents subsequently withdrew consent, leading to a total of 18 cases for analysis. An autopsy, scene investigation, and maternal/ family interview occurred in all 18 infant deaths, and the demises were classified by consensus of the PASS Pathology Committee (Tables 1 and 2). The investigation into the cause of death differed significantly not so much in the autopsy performed, but by the more complete scene investigations and maternal/family interviews instituted. Although the study consensus classification was totally independent of the FPS cause of death, there were no discrepancies between the two processes. All infant deaths had full autopsy with histology, bacteriologic and viral cultures, and HIV testing studies (Table 1). Per our inclusion criteria, all 18 deaths were sudden and unexpected, and occurred in the home after the discharge from the hospital (Table 2). All of these deaths were initially suspected to be SIDS/SUID prior to autopsy and

DSI. Only one death (Case 5) raised initial concern of a chronic disorder and with possible maltreatment due to apparent growth restriction of the infant (Table 2). In all 18 cases, a DSI was completed, with photographs in 83% (15/18). In the course of the feasibility study, personnel from the WCFPS identified questions on the CDC SUID form that were not applicable to the South African experience (e.g., central gas or electric furnaces, thermostat settings) (14), and accordingly, changes were made in the DSI protocol to delete these questions, thus affording a community-appropriate interview process. More specific questions about bed sharing (number of occupants, sizes of occupants, and positions in the bed) were added to better delineate the cosleeping patterns within the community. After the complete autopsy and DSI in each case according to standardized study protocols, the deaths were classified into the three categories of the 1990 NICHD schema (8): SIDS, $n = 7$ (38%); known/explained cause of death, $n = 7$ (38%); and unclassified, $n = 4$ (22%) (Table 1). The deaths occurred predominantly in males (67%; 12/18), as well as in infants born before term (<37 gestational weeks at birth) (56%; 10/18). The average postnatal age at death for all deaths was 2.5 months with a range from 3 days to 10 months. There were no parental reports of significant medical illness in the infants prior to demise, except for acute “fussiness” and mild upper respiratory signs in virtually all cases. It was expected that more in-depth questioning of the family would result in significantly richer information from which a cause of death could be formulated in association with the autopsy findings, but the small sample size was seen a limiting factor. None of the reported symptoms prior to death were thought to be severe enough by the parents to seek medical care. Seven deaths were classified as SIDS, with autopsy and DSI findings characteristic of SIDS in reports worldwide (1,16). Despite very careful consideration of the scene investigation and very specific, indepth questioning regarding exact sleep position etc., pathologists still felt very uncomfortable to call the cause of death as “possibly asphyxia-associated” unless the scenario was found to be very explicit in terms of the possibility of asphyxia, for example, an inebriated parent found to overlay an infant. Moreover, compelling evidence for obstruction of the nose and/mouth was considered necessary for a diagnosis of asphyxia.

We also observed minor (nonlethal) histopathologic changes that have been reported by others as typical in SIDS infants (16). These changes included mild pulmonary edema and intraalveolar hemorrhage, mild respiratory tract chronic inflammatory infiltrates, mild hemorrhage in the adrenal gland, and mild interstitial hemorrhage in the kidney (16).

Known Cause of Death

Seven cases were identified with defined (known), natural disease processes. The known causes of death in these cases were as follows: (i) disseminated tuberculosis with airway obstruction due to massive hilar adenopathy (Case 1) (17); (ii) disseminated cytomegalic inclusion viral (CMV) infection with pneumonia and myocarditis (Case 3); (iii) primary hepatic hemangioendothelioma with acute right heart failure (Case 7) (18); (iv) *E. coli* and CMV pneumonia (Case 10); (v) CMV pneumonia (Case 12); (vi) complications of meconium aspiration at birth (Case 14); and (vii) *Hemophilus influenzae* (*H. flu*) meningitis (Table 1). All of these diagnoses were unsuspected prior to autopsy. We have published separately the individual cases of disseminated tuberculosis (Case 1) (17) and hepatic

hemangioendothelioma (Case 7) (18) because of the unique and important points they raise related to the causes and mechanisms of SUID.

Unclassified

In four cases of sudden and unexpected death, certain findings at autopsy precluded a classification of SIDS because they did not appear lethal in themselves, but they raised the possibility that they were contributing factors to death. The cases were not classified as known causes of death because the findings were neither severe nor unequivocally indicative of lethality. Moreover, a lethal mechanism was not clear. These findings included milk aspiration in the lung (Case 6), which has been reported in mild degrees in SIDS infants (19), failure to thrive (Case 5), large patent ductus arteriosus with mild–moderate interstitial pneumonitis (Case 16), and protein-calorie malnutrition, which raised neglect as a consideration (Case 17). The single case of possible child neglect in this study was determined to be unfounded—the detailed DSI and interview playing a crucial part in this decision, although the cause of death remained unclassified due to the autopsy findings of failure to thrive and inflammatory cells in the lower gastrointestinal tract (Case 5).

Death Scene Investigation Findings

In this feasibility study, virtually all infants were found dead after a sleep period, mainly in the early morning, found by the mother, and were cosleeping on the night of death, irrespective of the classification of SIDS, known cause of death, or unclassified (Table 2). There were no cribs or separate infant sleeping surfaces in any case, and none of the deaths were considered accidents due to overlaying or body/head wedging after very careful DSI (Table 2). In all three categories, the main position in which the infant was found was side lying, but some infants were found prone in all three categories (Table 2). Male gender, postnatal age at death, and history of minor signs of illness around the time of death (Tables 1 and 2) did not appear to be distinguishing features between the three categories. Preterm birth, however, may be distinguishing in unexplained deaths (SIDS and unclassified, 71% and 75% preterm, respectively) compared to known causes of death (29% preterm). Furthermore, prone position was seen in only 14% of SIDS cases and more common in known causes of death and unclassified cases (29% and 25%, respectively) (Table 2).

Discussion

This feasibility study demonstrated that implementation of a SIDS/SUID death investigation fully meeting high international standards can be achieved in the Eastern Metropole, a region with a high SIDS rate and significant infrastructure challenges. The success of this study was valuable for families, health practitioners, the targeted communities, public/community health mandates, and the South African FPS.

Potentially problematic was the use of the term SIDS in the classification of deaths as its use has become increasingly controversial and, in some forensic systems, is not longer applied to sudden unexplained deaths. The focus of the controversy is the presumption that asphyxia plays an important role in the cause of death when the infant is found prone or cosleeping, and consequently, classification schemas that are based upon asphyxial risk have been

suggested to be more appropriate (20,21). In the entire Safe Passage Study in progress now of the 12,000 pregnancy follow-ups, we are adjudicating all deaths according to various classification schemes (Randall, Krous, NICHD), as well as a study designed protocol of explained versus unexplained deaths without the use of the term SIDS. At the end of the entire study, we will compare the outcome of the study based upon the different definitions of the classification schema for sudden unexplained infant death. In this pilot study, we used the NICHD 1990 definition to define unexplained deaths, with no assumption that risk factors related to unsafe sleep, for example, discovery face down or prone, bed sharing, played causative roles related to potential asphyxia. The current hesitance by pathologists to classify cases as potentially asphyxia-associated is thought to also be due at least in part to the legal system in South Africa and the potential repercussions of such a label in the case. The concern over sleeping practices and the growing awareness of international practice has led to improved scene investigation and case assessment—an identified focus area for further reporting of the Cape Town experience.

The training in and utilization of the research DSI subsequently formed the basis for the forensic DSI in cases of sudden infant death in the workflow of WCFPS that is currently in use. While this study is not designed as a case-control study with a large sample size, the DSI findings in these 18 cases provides an initial basis for evaluation of infant mortality in the Safe Passage Study catchment area in Cape Town, including both similarities and differences between subtypes of infant deaths—of direct relevance to the second phase currently under way.

Importantly, complete infant death investigations with autopsy, histology, bacteriologic and virology studies, including for HIV, identified a known cause of death in almost 40% of the infants. Of note, almost three-quarters of these known causes were due to infection, including unrecognized and hence untreated bacterial meningitis, a not surprising observation given the well-recognized role of infection in infant mortality in South Africa (22,23). The case of (unsuspected) disseminated tuberculosis (Case 1) had major community and public health implications, underscoring the importance and public health implications of thorough autopsies in sudden infant death investigations (17). In another case (Case 14), valuable clinical feedback was provided to healthcare workers who had not recognized meconium aspiration in a one-day-old infant discharged from the hospital. In the case of hepatic hemangioendothelioma (Case 7), a new clinical presentation of this tumor, that is, as sudden and unexpected death, was recognized and reported (18). In yet another case (Case 5), initial suspicions of forensic investigators for potential child neglect were assuaged by autopsy findings, preventing potentially unjust legal action against the parents. The delineation of the category of SIDS among infant deaths by complete autopsy and DSI defines also for the community the extent of the problem and helps provide a solid basis for future allocation of resources for community risk reduction programs and scientific research. The demarcation of a fraction of unclassified cases highlights the difficulties in elucidating the mechanisms and risks of sudden infant death, again mandating further research. This also focused attention on the subcategory of cases in which compromise of the airway may have played a role. A more extensive evaluation of more SUID cases is required to fully understand the possible challenges in understanding possible asphyxia-related cases.

Although the number of infant demises was small, the high percentage of infants born prematurely (56% of all categories and 71% of SIDS infants) raises concern about the role of prematurity in sudden infant (postdischarge) death in the studied region, thereby identifying a potentially critical issue for further research. The finding of universal cosleeping on the night of death, including in infants with unequivocally lethal disease (e.g., hepatic neoplasm with acute right heart failure, disseminated tuberculosis with massive hilar adenopathy and airway obstruction) underscores the importance in forensic SUDI examination to always consider alternative modalities. The widespread sleep practice of bed sharing, combined with the high rate of preterm delivery, raises concern about small infants sleeping with large adults and the possibility of overlaying. Eliminating cosleeping in this impoverished region, where often there is only one bed in a one room flat for an entire family, indeed presents challenges, but community education with improving safe sleep practices for very small infants is feasible and has been initiated by the local forensic community. This is one tangible and high impact value to the community aimed at reduction of infant deaths.

This feasibility study demonstrated that integration of forensic investigations and research studies could be accomplished (11). Furthermore, the cooperation between forensic personnel, clinical providers, and researchers improved the forensic investigations, perceived community value, and research data. The authors attribute several factors to this success. First, the separation of “forensic” and “research” studies was clearly delineated to the parents in both the process of investigation (separate investigation and personnel), and reporting information obtained (scene details for forensic investigation; maternal alcohol and smoking reports for research studies), yet all information was considered in the making of the diagnosis of the cause of death. The fully consented integration of the investigation modalities also demonstrated respect and sensitivity toward grieving parents by minimizing the repetition of questions about the infant demise repeated in the research interview, while confirming key circumstances for accuracy. Personally meeting the clinical investigators for consent was among the key factors for autopsy research consent (24). The integral involvement of WCFPS in the design and study protocols enhanced and at times directly modified the protocols for the research study, as illustrated in the deletion of nonapplicable questions about home heating, and the addition of specific questions about cosleeping patterns relevant to the community.

The implications of the capability to establish a functional infrastructure for the investigation of SUID in the “Cape Flats” region extend beyond this population. In the United States today, for example, three-quarters of all SIDS deaths occur in socially disadvantaged families (1). In a New Zealand study, the SIDS rate among low-income families was 4.6/1000 compared to 1.2/1000 among the higher income brackets ($p < 0.001$) (2). In the United Kingdom, the proportion of SIDS deaths in families with socioeconomic deprivation increased from 47% to 74% ($p = 0.003$) following the initiation of national risk reduction programs, such that SIDS now occurs in that country mainly in the poor (3). The highest SIDS rates today occur among racial and ethnic groups that are also socioeconomically disadvantaged, including the American Indians in the Northern Plains, African Americans in the United States, Maoris in New Zealand, and Aboriginal Australians (1,25). While the reasons for the socioeconomic disparities in SIDS rates are incompletely understood, they

likely involve complex interactions between genetic and environmental factors, as well as suboptimal risk reduction messages in underserved medical communities (1). The environmental factors include a high load of known SIDS risks, including inadequate access to prenatal care, prematurity, and maternal drinking, smoking, and illicit drug use during pregnancy (1). For SIDS to be eradicated worldwide, efforts to understand its causes and pathogenesis must be undertaken directly in the populations most at risk—those living in poverty. With greater community interaction, the importance of conducting the medico-legal investigation and discussing the findings expediently with the parents became readily evident. Due to the nature of medicolegal investigation and inquest in South Africa, and previously poorly developed social services, adequate feedback to parents of deceased infants is logistically challenging. Since the feasibility study, Forensic Pathology Officers are focusing on parental feedback, as well as the right of parents to feedback from pathologists. This has resulted in more frequent telephone consultations from parents regarding cause-of-death information. Parental and community counseling is hampered by the geographic remoteness of areas as well as underdevelopment of social service infrastructure within the WCFPS and community at large.

In conclusion, infant death investigations that meet high international standards while remaining culturally sensitive to the community can be devised and implemented even in those communities with significant poverty and infrastructure challenges. A high level of intra-institutional and international cooperation and collaboration allows routine infant death investigations to be incorporated into internationally structured SIDS/SUID research investigations. Complete autopsies and death scene investigations were instrumental in identifying a known cause of death for nearly 40% of the infants in this study, underscoring the importance of complete pediatric autopsies in all infant death investigations. A community responsive death investigation drives locally based improvements in infant care practices with the aim of reducing infant mortality. Finally, investigations of SUID/SIDS in this region that fully meet accepted standards of infant death investigation contributes to accurate assessment of SIDS rates and confounding illnesses, volitional acts, and infant care practices that affect infant deaths. This knowledge is critical for global initiatives in SIDS/SUID toward understanding this major cause of infant mortality worldwide.

Recommendations

This pilot has illustrated the feasibility of the investigation of SUID cases to internationally competitive standards. The following issues were elucidated by the project:

- The total compliment of SUID cases needs to be examined in the Western Cape Metropole to more clearly define the profile of these deaths and the problem of SUID in the Cape.
- Following this, a SUID registry needs to be established that also monitors by means of Child Death Review (CDR) all future cases of infant demise in the Western Cape province. This incentive is already in the planning phase in conjunction with the other large medico-legal center in the Cape Town metropole, and full CDR is expected to be implemented in 2016.

- This pilot has clearly delineated the need for further intra- and interinstitutional as well as international collaboration to further develop the forensic services in the country.

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TABLE 1

Summary of 18 cases in feasibility study of sudden and unexpected death.

Case	Sex	Age (Months)	DSI Photographs	Autopsy	HIV and Viral Testing	Bacterial Cultures	Histology	Maternal / Parental Interview	Initial Assessment	Final Demise Classification
1	M	4	Y	Y	Y	Y	Y	Y	SIDS	KCOD: Tuberculosis
2	F	10	Y	Y	Y	Y	Y	Y	SIDS	SIDS
3	F	2	Y	Y	Y	Y	Y	Y	SIDS	KCOD: Disseminated CMV infection with myocarditis and pneumonitis
4	M	1	Y	Y	Y	Y	Y	Y	SIDS	SIDS
5	F	0.5	Y	Y	Y	Y	Y	Y	Unclassified	Unclassified: Failure to thrive, inflammatory cells in gut
6	F	7	Y	Y	Y	Y	Y	Y	SIDS	Unclassified: Milk aspiration
7	M	1	P*	Y	Y	Y	Y	Y	SIDS	KCOD: Hepatic hemangioendothelioma
8	F	3	Y	Y	Y	Y	Y	N [†]	SIDS	SIDS
9	M	2	Y	Y	Y	Y	Y	Y	SIDS	SIDS
10	M	2	Y	Y	Y	Y	Y	Y	SIDS	KCOD: Pneumonia with E. coli and CMV (HIV testing-negative)
11	M	2	Y	Y	Y	Y	Y	Y	SIDS	SIDS
12	M	3	Y	Y	Y	Y	Y	Y	SIDS	KCOD: CMV pneumonitis
13	M	0.5	Y	Y	Y	Y	Y	Y	SIDS	SIDS
14	M	0.1	Y	Y	Y	Y	Y	Y	SIDS	KCOD: Meconium aspiration
15	M	1.5	Y	Y	Y	Y	Y	Y	SIDS	SIDS
16	M	0.25	Y	Y	Y	Y	Y	Y	SIDS	Unclassified: Large patent ductus arteriosus, moderate, interstitial pneumonitis
17	M	4	Y	Y	Y	Y	Y	Y	SIDS	Unclassified: Protein-calorie malnutrition
18	F	1.5	Y	Y	Y	Y	Y	Y	SIDS	KCOD: H Flu meningitis

Y, Yes; N, No; KCOD, Known (explained) cause of death; HIV, human immunodeficiency virus; CMV, cytomegalic inclusion virus; SIDS, sudden infant death syndrome.

* partial scene investigation; detailed assessment not performed due to autopsy findings of neoplastic disease.

[†] parents declined interview and were lost to further investigation.

TABLE 2

Infant death variables in 18 sudden and unexpected infant deaths in the feasibility study (Phase 1) of the Safe Passage Study.

Variable	SIDS (<i>n</i> = 7)	Unclassified (<i>n</i> = 4)	Established Cause (<i>n</i> = 7)
Postnatal age	2.9 months (0.5–10 months)	2.9 months (1 week to 7 months)	2 months (3 days to 4 mo)
Gestational age	34 weeks (32–38 weeks)	33 weeks (32–37 weeks)	36 weeks (34–39 weeks)
Premature	71% (5/7)	75% (3/4)	29% (2/7)
Found by mother	86% (6/7)	100% (4/4)	100% (7/7)
Found after a sleep period	100% (7/7)	100% (4/4)	100% (7/7)
Found in morning	86% (6/7)	100% (4/4)	100% (7/7)
Found prone	14% (1/7)	25% (1/4)	29% (2/7)
Found supine	29% (2/7)	25% (1/4)	14% (1/7)
Found side	57% (4/7)	50% (2/4)	57% (4/7)
Found cosleeping	100% (7/7)	100% (4/4)	100% (7/7)
Number of cosleepers	1.5 (range: 1–3)	1.7 (range: 1–3)	1.5 (range: 1–4)
Soft bedding	86% (6/7)	50% (2/4)	71% (5/7)
Evidence of wedging	0% (0/7)	0% (0/7)	0% (0/7)