The South African child death review pilot: A multiagency approach to strengthen healthcare and protection for children

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Background. Child mortality trends in South Africa (SA) show a decrease, but remain high and appear to have plateaued. To attain the new sustainable development goals, we need a better understanding of causes of death and the associated factors.

Objectives. To describe the SA child death review (CDR) pilot, the pattern of child deaths reviewed and the factors associated with these deaths.

Methods. CDR teams were established at two pilot sites, Salt River mortuary (Western Cape Province) and Phoenix mortuary (KwaZulu-Natal Province). All child deaths were reviewed by a multidisciplinary team at the pilot sites for the period 1 January 2014 - 31 December 2014.

Results. The CDR pilot reviewed 711 cases. Over half (53.3%) were natural deaths, as opposed to 42.6% non-natural deaths. Most infant deaths (83.9%) were due to natural causes, while 91.7% of deaths in the 15 - 17-year-old group were due to injuries. The leading cause of deaths reviewed (30.8%) was respiratory tract infection (RTI), mainly among infants (51.6%). Homicide was the second most common cause of death and affected children of all ages, with the highest burden (52.8%) in the 15 - 17-year-old group. Child abuse and neglect accounted for 11.3% of deaths. RTI was shown to be more likely after the neonatal period (odds ratio (OR) 2.92; p<0.000) and in preterm infants (OR 1.98; p=0.005).

Conclusions. CDR teams have been effective in improving identification of the causes of out-of-hospital deaths, as well as by identifying remediable factors critical to reducing child deaths further.
Objectives
Based on the gaps identified by the MRC child homicide study and a review of international practices to manage child deaths, CDR teams were implemented and tested at two pilot sites in SA. The objective was to test the effectiveness of the teams in strengthening response systems and preventing child deaths in the local setting. This article describes the pattern of deaths reviewed and how the data can strengthen the current health and child protection system to improve the wellbeing of children.

Methods
The pilot was established at two sites for the period January - December 2014. Salt River (Western Cape) and Phoenix (KwaZulu-Natal) mortuaries were purposefully selected because of an interest by the forensic pathologists, the different sizes of the mortuaries (based on the number of bodies examined) and the diversity of the catchment districts. Phoenix mortuary, classified as M5, is based in Durban North with its area including the large informal settlements of KwaMasule and Inanda as well as the outlying rural areas of Ndwedwe and Ntuzuma. Salt River mortuary is an M6 mortuary that serves the suburbs, townships and informal settlements of Cape Town with catchment extending from Atlantis to Kommetjie, and from Camps Bay to Mitchell’s Plain. (Designated facilities in the Forensic Pathology Service (mortuaries) are classified nationally according to their caseload per annum, M5 having a caseload of 1 500 - 1 999 bodies per annum and M6 ≥2 000 bodies per annum.)

The CDR concept
The pilot was initiated by the Children’s Institute, University of Cape Town, to foster an intersectoral collaborative approach to gather data systematically for each child death presenting to a medicolegal laboratory (mortuary). At the core of the process is the multidisciplinary team with representatives from law enforcement, social services, health, forensic pathology and prosecution services who meet retrospectively to share case-specific information and review the circumstances of child deaths.[9,10] CDR teams have been in operation in high-income countries for the past two decades, and to our knowledge this was the first attempt to test their feasibility in a low- or middle-income country.

CDR teams met monthly to review all child deaths (birth to 17 years of age) retrospectively, with a rapid, standardised response to the investigation, particularly for sudden, unexpected deaths. A standardised data collection form captured demographics, medical history and cause-of-death data. The monthly review followed a standardised approach, with the forensic pathologist leading the discussion and all team members undertaking a confidentiality agreement. The review focused on identifying the events that led to the death based on the medical history and police investigation, identified additional information required, and established whether the death was preventable by considering potential modifiable or remediable factors.

Definitions
This study used the United Nations Convention on the Rights of a Child definition of a child as a person aged <18 years. We defined a neonate as a newborn aged <28 days and an infant as aged <365 days but out of the neonatal period.

The Inquests Act[11] provides that a postmortem examination be performed to determine the cause of any death deemed not to be from natural causes and to establish who is responsible for the death. Unnatural deaths are defined in the Regulations to the National Health Act regarding the rendering of Forensic Pathology Service[12] and include deaths from external causes and sudden, unexpected and unexplained deaths.

We defined fatal child abuse and neglect as a death due to physical abuse or neglect or negligence in the context of a relationship of responsibility and care, i.e. where the responsible person was a parent or caregiver; based on the Children’s Act,[13] neglect or negligence was defined as the omission of care resulting in the death of a child and often related to a natural cause of death. All cases of suspected rape and sexual assault were based on the postmortem findings and the police investigation, and were included as part of the definition of fatal child abuse. Live births were included in the study, based on postmortem examination, and a gestational age of 26 weeks was used as a marker for viability as defined by the Births and Deaths Registration Act.[14]

Statistical analysis
Data were analysed with Stata version 13 (StataCorp, USA). Descriptive statistics (means and proportions) were calculated and categorical variables were compared using Pearson’s χ2 tests. A logistic regression analysis was used to identify factors associated with death. Mortality rates were calculated using 2014 live births and population estimates from the City of Cape Town and live birth and population estimates for the eThekwini district in KwaZulu-Natal as the denominator.

Ethical considerations
Ethical approval for the study was granted by the Ethics Committee of the Faculty of Health Sciences, University of Cape Town (HREC 396/2013).

Results
We reviewed 711 child deaths at the two sites for the pilot period. Salt River mortuary had 548 cases, three times the number of cases (163) reviewed at Phoenix. Table 1 shows a mortuary-specific child death rate of 8.1 deaths per 1 000 live births for infants and 34 per 100 000 for children aged 1 - 14 years at Salt River mortuary and 2.0

| Table 1. Description of infant and child death rates and non-natural death rates at the two pilot sites for 2014 |
|------------------------------------------------------------------------------------------------|
| Mortuary-specific infant death rate (1/1000 live births) | Mortuary-specific child death rate, 1 - 4 years (1/100 000) | Mortuary-specific child death rate, 5 - 14 years (1/100 000) | Total mortuary-specific child death rate, 1 - 14 years (1/100 000) |
| Overall death rate, Cape metro | 8.1 | 58.4 | 24.3 | 34.0 |
| Overall death rate, northern eThekwini | 2.0 | 34.3 | 19.9 | 24.5 |
| Non-natural death rate, Cape metro | 0.7 | 30.7 | 20.0 | 23.0 |
| Non-natural death rate, northern eThekwini | 0.7 | 28.0 | 17.0 | 17.9 |
deaths per 1 000 live births for infants and 24.5 per 100 000 for children aged 1 - 14 years at Phoenix mortuary.

Fig. 1 shows that Salt River mortuary saw significantly more natural deaths (60.6%) than Phoenix mortuary (27.6%). The proportion of deaths with an undetermined cause was similar for both sites.

Table 2 shows the combined pattern of child mortality by age category. Overall, just over half (53.3%) were natural deaths, compared with 42.2% non-natural deaths and 4.5% from undetermined causes. Of the 374 infant deaths reviewed, most (83.7%) were due to natural causes. The proportion of natural deaths decreased as age increased, accounting for only 6.4% of deaths of 15 - 17-year-olds. The opposite was found with non-natural deaths, which increased sharply from 59.1% in the 1 - 4-year age group to 91.7% in the 15 - 17-year age group. Overall, children were more likely to die at home than in hospital (52.4%), infants in particular (68.9%). Children aged >14 years were more likely (58.3%) to die in public spaces than younger children (10.4%). Less than one in five child deaths reviewed (16.1%) were in-hospital deaths, with the highest proportion (20.2%) of in-hospital deaths in the 1 - 4-year age group.

Overall, the leading cause of death in children referred to the mortuaries was respiratory tract infection (RTI), resulting in nearly a third of deaths (30.8%) and accounting for more than half (51.6%) of deaths in children aged <1 year. Homicide was the second most common cause and spanned all age groups, with the highest burden in the 15 - 17-year age group (52.8%). Suicide accounted for 12.0% of deaths in this older group. Road traffic accidents (RTAs) accounted for 12.3% of all deaths and peaked (40.0%) in the 5 - 14-year age group. Child abuse and neglect accounted for 11.3% of deaths, with the highest proportion of deaths (13.5%) in the >5-year age group.

Table 3 shows the pattern of deaths in the under-5 age group. RTI was the most common cause (41.9%), followed by deliberate injury, abuse or neglect (13.3%) and other perinatal causes (10.4%). Similarly, RTI was the leading cause of death (58.2%) in the 1 - 11-month age group, followed by deaths from diarrhoea (12.9%) and from deliberate injuries, abuse and neglect (10.3%). In addition, 1 in 5 children aged 1 - 4 years died as a result of an RTA.

Table 4 shows the factors associated with RTI deaths in infants. A death from a lower RTI was most likely after the neonatal period (odds ratio (OR) 2.92; p<0.000) and in preterm infants (OR 1.87; p<0.009). Infants who...
died unexpectedly at home were more likely to have died of an RTI than infants who died in hospital (OR 2.60; p=0.002), and infants were more likely to die in winter than in summer (OR 1.93; p=0.025).

Table 3. Underlying causes of death in the under-5 age group

| Cause of death                  | 0 - 28 days (n=113), % | 1 - 11 months (n=263), % | 1 - 4 years (n=104), % | Total <5 years (N=480), % |
|--------------------------------|------------------------|--------------------------|------------------------|--------------------------|
| Related natural causes         |                        |                          |                        |                          |
| Congenital                     | 3.5                    | 3.0                      | 1.0                    | 2.7                      |
| Diarrhoea                      | 0.0                    | 12.9                     | 7.7                    | 8.8                      |
| Lower RTI                      | 27.4                   | 58.2                     | 16.4                   | 41.9                     |
| Stillborn                      | 34.5                   | 0.0                      | 0.0                    | 8.1                      |
| Other natural                  | 8.9                    | 5.3                      | 7.7                    | 6.7                      |
| Related external causes        |                        |                          |                        |                          |
| Child abuse and neglect        | 19.5                   | 10.3                     | 14.4                   | 13.3                     |
| RTA                            | 0.0                    | 0.4                      | 21.2                   | 4.8                      |
| Other external*                | 2.7                    | 5.7                      | 30.7                   | 10.4                     |
| Undetermined                   | 3.5                    | 4.2                      | 1.0                    | 3.3                      |

*Includes drownings, fire deaths, procedure related, accidental injury and poisoning.

Table 4. Factors associated with lower RTI during infancy

| Variable               | OR  | 95% CI       | p-value |
|------------------------|-----|--------------|---------|
| Age                    |     |              |         |
| Neonate                | Ref | -            |         |
| 1 - 11 months          | 2.92| 1.74 - 4.92  | <0.000  |
| Prematurity            |     |              |         |
| Term                   | Ref | -            |         |
| Preterm                | 1.87| 1.17 - 2.99  | 0.009   |
| Place of death         |     |              |         |
| Hospital               | Ref | -            |         |
| Home                   | 2.60| 1.44 - 4.68  | 0.002   |
| Public space           | 0.46| 0.17 - 1.23  | 0.122   |
| Season                 |     |              |         |
| Summer                 | Ref | -            |         |
| Autumn                 | 1.29| 0.66 - 2.53  | 0.460   |
| Winter                 | 1.93| 1.09 - 3.41  | 0.025   |
| Spring                 | 0.14| 0.85 - 3.19  | 0.137   |

CI = confidence interval.

Discussion

This is the first CDR process for SA. The formation of multiagency teams to review child deaths at the two pilot sites provided invaluable insights into out-of-hospital deaths. This multidisciplinary enquiry enabled the co-ordinated investigation of deaths using evidence from medical records, autopsy reports, police and social services investigations. Each CDR team member played a specific role in the investigation, and the monthly meetings facilitated good communication that led to a real-time response to child death management and investigation.

The death notification system has been criticised for lacking completeness of child death data, misclassification and miscoding cause of death.[10] The CDR has shown the potential to increase accuracy in determining causes of death and to reduce undetermined or ill-defined causes to complement the Child PIP audit of in-hospital child deaths. Furthermore, the CDR process, through the review and co-ordinated response to the investigation and management of suspected abuse and neglect cases, facilitated an increase in identification of such cases, while the involvement of a child protection agency allowed for supporting families in crisis and protecting other children at risk in the family. We referred 52 cases for family support and recommended an investigation into the care of remaining children to a child protection agency; 33 referred cases were verified as neglect or omission of care.

At the core of the CDR process is an enquiry into each death by using a set of questions that investigate the web of factors that contributed to the child’s death, particularly in sudden, unexpected and injury deaths. This requires an understanding of the deaths in the context of their environment, including factors at various levels: individual (biological and psychological), family, social, cultural, health and social welfare system issues that influence access to care; and the care the child received.[11] In 13.2% of child deaths, caregivers abused substances and this may have affected their ability to care for the child adequately and seek timeous medical assistance. Where parents sought medical treatment, we found that health system failures potentially contributed to a further 11.2% of deaths. The pilot has shown that each child death provides a unique opportunity to understand contributing factors to ensure that appropriate prevention interventions are introduced.

What is the pattern of deaths telling us?

More than half (53.3%) of the child deaths reviewed were due to natural causes. This pattern differed by mortuary, with Salt River admitting a larger proportion of natural deaths. Although eThekwini district in KwaZulu-Natal has a higher proportion of deaths in the health sector than the City of Cape Town,[16] this cannot fully explain the large difference. Despite the fact that medical practitioners should not be signing death notifications for sudden unexpected deaths, as per the National Health Act, our findings confirm the national child homicide study findings that teenage boys were most likely to die due to interpersonal male-on-male violence, and children aged <5 years to die in the home as a result of abuse and neglect.[6] The pilot revealed that the majority of deaths of teenagers occurred in the context of peer conflict and gang-related violence, particularly in the Cape metropolitan area. Violence among young males is theorised to be deeply rooted in the context of inequality.
and youth unemployment in SA.[21] In this context violence remains engendered as young men strive to attain violent forms of masculinility as the hegemonic ideal of what it means to be a ‘real’ man.[18] Efforts to reduce youth violence require significant investment in adopting an approach that targets risk and promotes resilience during early childhood.

We found that child abuse deaths in the home contributed substantially to the burden of deaths in the under-5 age group. Deaths due to severe physical abuse are most likely to be recognised as abuse deaths, while deaths related to omission of care, such as neglect, abandonment, drowning and poisoning, often remain undetected.[19] The use of a CDR increased the accuracy of cause of death, and the team discussion facilitated in-depth enquiry to determine the circumstances surrounding each death. This resulted in an additional 33 cases of neglect or omission of care being identified. Although neglect did not necessarily cause the death, failure to seek timely medical attention or lack of adequate supervision at the time of death contributed to it.

The early neonatal period was identified as a period of great risk, with 1 in 5 such deaths related to abandonment or being killed shortly after birth. This finding is supported by the national study on child homicides, which estimated that SA had one of the highest reported rates of neonaticide, at 19.6 per 100 000 live births.[20] Fatal child abuse homicides, which estimated that SA had one of the highest reported rates of fatal child abuse, contributed to it.

This finding is supported by a review of child mortality in high-income settings, which concluded that a purely medical approach is inadequate and a social autopsy approach, examines the social factors contributing to child deaths in conjunction with medical causes to gain a better understanding of why and how children are dying. The pilot highlighted a dual problem: children aged <5 years are continuing to die from acquired natural causes (lower RTI), and there is a risk of fatal child abuse at home. The insights from this pilot clearly highlight the need to introduce and strengthen community-based interventions to assist in early identification of high-risk mothers through targeted support services and home-visit programmes, particularly for preterm babies and high-risk mothers. There is a critical need to strengthen child protection services, with early intervention and prevention programmes needed to reduce the risk of fatal child abuse. Furthermore, interventions to strengthen families are vital to reduce child deaths but require investment in innovative multipronged programmes supported at the highest level to achieve global targets.

Conclusions

The CDR pilot has provided valuable insights into out-of-hospital deaths. The review process, through in-depth case discussion using a social autopsy approach, examines the social factors contributing to child deaths in conjunction with medical causes to gain a better understanding of why and how children are dying. The pilot highlighted a dual problem: children aged <5 years are continuing to die from acquired natural causes (lower RTI), and there is a risk of fatal child abuse at home. The insights from this pilot clearly highlight the need to introduce and strengthen community-based interventions to assist in early identification of high-risk mothers through targeted support services and home-visitation programmes, particularly for preterm babies and high-risk mothers. There is a critical need to strengthen child protection services, with early intervention and prevention programmes needed to reduce the risk of fatal child abuse. Furthermore, interventions to strengthen families are vital to reduce child deaths but require investment in innovative multipronged programmes supported at the highest level to achieve global targets.

Study limitations

We consider the determination of RTI in the infant cohort a possible limitation. The autopsy rate for infants varied between Phoenix (98.0%) and Salt River (48.8%). While there is no indication that the lack of standardised protocols across the two mortuaries led to under- or over-diagnosis of RTI deaths, this finding is consistent with international reports of pneumonia being the leading cause of death in children aged <5 years, particularly in Africa.[22] The standard practice at Salt River in cases of natural death when no autopsy is performed is to arrive at the diagnosis on the basis of a full medical and social history, an Xmplar-dr chest X-ray (Lodox, SA) and full external examination. This practice is akin to the clinically diagnosed RTI in epidemiological surveys.[24]

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