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## **Death-scene investigations contribute to legal protection in unexpected child deaths in Norway**

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Running title: Death-scene investigations as legal protection for children

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**Abstract**

**Aim:** This study reviewed cases of sudden unexpected child deaths in Norway to determine the significance of death-scene investigations (DSIs) in establishing cause and manner of death, and thereby its relevance to legal protection.

**Methods:** Data from forensic autopsy reports and DSIs were collected and analysed for cases of unexpected deaths in children below four years of age in Norway during 2010–2016.

**Results:** Out of 141 cases, the death scene was investigated as a voluntary procedure in 75 cases and by the police in 41 cases. The cause of death remained unexplained in 81/141 (57%) of the cases, of which 46/141 (33%) met the criteria for Sudden infant death syndrome (SIDS) or Sudden unexplained death in early childhood (SUDC). The manner of death was determined in 102/141 (72%). Voluntary DSI increased the ability to rule out accidental suffocation, facilitated evaluations of environmental risk factors, and enabled detection of possible neglect.

**Conclusion:** DSIs illuminate uncertainty about the cause of death, especially in gray-area cases where accidental suffocation, neglect or abuse is suspected. Knowledge about the course of events and the cause of death enhances both the child's and the caregiver's legal protection. DSIs should therefore be mandatory.

**Keywords:**

Accidental suffocation, Death-scene investigation, Sudden infant death syndrome, Sudden unexplained child death, Unexpected child death

**KEY NOTES:**

- The diagnostic workup in cases of sudden and unexpected deaths of small children is challenging, but performing death-scene investigations can improve the degree of certainty about causes of death.
- The legal protection for children and their caregivers become enhanced by the use of death-scene investigations.
- Death-scene investigations should be mandatory.

## INTRODUCTION

Every year an average of 30–35 children younger than four years die suddenly and unexpectedly in Norway. The cases require a careful balance between the children's right to legal protection, the duty to investigate criminal acts and the responsibility to care for the bereaved families.

Doctors are legally obliged to report these deaths to the police. The police then initiate an investigation, independent of any suspicion of a criminal act, to gather information. The investigation includes ordering a forensic autopsy and sometimes also a death scene visit. Depending on the outcome, the police will either continue with a thorough investigation if a criminal act is suspected or postpone investigation pending the final forensic autopsy report. The latter are open to proceed with a voluntary death-scene investigation (DSI) (1, 2).

Since November 2010, DSIs have been offered in all regions of Norway as a voluntary healthcare service in cases with no suspicion of a criminal act. The DSI teams consist of personnel with interdisciplinary background and include one of the forensic pathologists that performed the autopsy and personnel with education and experience from police investigations. The DSI personnel report to the healthcare.

The main purpose of DSI is to help determine the cause and manner of death. Cause of death indicates that the death is due to a specific injury or diagnosis, whereas the manner of death describes the circumstance that led to death. A secondary goal of the DSI service is to gather data about known and possibly unknown risk factors in order to help prevent future deaths.

DSI is not based on legislation, but rather on a decision to fund it by the Norwegian Parliament. The implementation of DSI was a part of the Government's increased focus on safeguarding children. The Department of Forensic Sciences at Oslo University Hospital has a nationwide responsibility to coordinate the DSI service.

Norway is the only Nordic country that offers such a model of voluntary DSIs. Several countries including USA, UK, Australia and New Zealand have implemented systems of systematic

child death reviews. These often include two elements: a rapid response and a retrospective review, with the latter primarily aimed at providing a learning perspective (3, 4).

The aim of the present paper was to study whether DSI improves the diagnostic accuracy and thereby enhances the legal protection for children and their families.

## **METHODS**

### **Case selection and data collection**

Data were collected on 200 cases of sudden unexpected (5, 6) deaths of children younger than four years where a forensic autopsy had been performed during November 2010 to December 2016. In 4/200 cases we were unable to collect sufficient information for the analysis and so they were excluded (Figure 1). Another 35 neonatal deaths were excluded because the primary reason for requesting the autopsy in these cases was to establish if the deaths could be attributed to medical malpractice in connection with pregnancy or birth. Furthermore, 20 sudden deaths while in hospital care were also excluded (Figure 1). The remaining 141 cases were included in the present study. Data from the written case reports were entered into a SPSS database to analyse the effect of the implementation of DSI.

Forensic autopsies were carried out at the five regional forensic centers in Norway in accordance to the international standardized autopsy protocol for Sudden infant death syndrome (SIDS) (7) while applying the diagnostic criteria of the Nordic protocol (8) as subsequently revised by Bajanowski et al. (9).

Voluntary DSI is to be performed within 48 hours after the death of the child and includes a thorough interview with the parents, followed by an examination of the death scene and reconstruction of the event, using special handmade dolls that match the child's age and weight (1). The parents were asked to use the doll to explain and show the different positions adopted by the child. The reconstruction was photographed for documentation purposes.

When reviewing the cases, we found some differences in how the diagnostic criteria had been applied. In order to obtain an equal basis for assessment in the present study, all cases were strictly classified according to the definitions of SIDS (10) and Sudden unexplained death in early childhood (SUDC) (11). All cases were categorized into explained and unexplained, the latter including cases that met the criteria for SIDS or SUDC, and cases for which alternative diagnoses are equivocal (Table 1). Asphyxia was designated as cause of death when circumstantial information disclosed airway obstruction. The possibility of unintentional asphyxia was considered for all cases of unexplained cause of death based on the available information.

The manner of death is in Norway ultimately decided by the police, but for this study it was classified into natural, undetermined and unnatural, based on the information collected, with no regard to the outcome of a possible police investigation (Table 2). The undetermined classification was used when an accident, homicide or other inflicted cause could not be ruled out. Undetermined also include cases with indications of infant drug poisoning and the presence of injuries of uncertain significance. We further classified deaths with no examination of the death scene as undetermined. Cases that met the criteria for SIDS or SUDC and as such had been fully examined with forensic autopsy and by inspection of the death scene, either by police or the DSI team, were categorized as natural manner of death.

### **Ethical approval**

All parents for whom DSIs were applied gave their written consent prior to the investigation. This study was approved by the Norwegian Directorate of Health and the Director of Public Prosecutions, who also granted the right to access confidential information in medical records and forensic autopsy reports. The Norwegian Data Protection Authority approved the study in terms of the disclosure and protection of personal data.

## RESULTS

A total of 141 cases of sudden unexpected deaths in infancy and early childhood were included. The police investigated the death scene in 41 of these, based on suspicion of a criminal act being involved. Voluntary DSI was thus applicable in 100 cases and offered to 94 families, of which 75 (80%) gave their consent to participate. Six families were never offered voluntary DSI due to a mistake. The proportion of cases investigated by voluntary DSI varied significantly between different regions of the country, from 75% of the cases examined in Tromsø and 65% in Oslo, to less than 33% examined in the other three cities ( $p < 0.001$ ). Cases allocated to Trondheim were more likely to be investigated by the police (78%) than cases in Oslo (29%) and the other cities ( $p < 0.01$ ). The death scene was not investigated either by the police or by voluntary DSI in 25/141 (18%) cases (Figure 2). In Bergen 48% of the cases were not investigated (Figure 2).

### Age and sex distribution

Among the 141 deaths, 61% of the victims were males, 28% were younger than 3 months, 58% were younger than 12 months, and 85% were younger than 24 months (Figure 3). The victims with voluntary DSI ( $n=75$ ) were significantly younger than the cases ( $n=86$ ) subject to either police investigation or no investigation of the death scene ( $p=0.001$ ). The DSI group comprised 33% younger than three months and 68% younger than 12 months, compared to 23% and 51%, respectively, in the non-DSI group (Figure 3). The sex distribution did not differ significantly between the DSI and non-DSI groups.

### Cause and manner of death

A cause of death was determined in 60/141 (43%) of the cases and thus designated explained deaths (Table 1). SIDS and SUDC were not considered explained deaths. There were 12/141 (9%) children who died due to physical injuries, secondary to violence or accident. Based on the findings at autopsy or the investigation of the death scene, 14/141 (10%) cases were concluded with death due

to asphyxia. In total, the police investigation concluded with an explained cause of death (in 31/41 (76%) cases, whereas for the DSI-cases an explained cause of death was found in 23/75 (30%) cases. In infants aged below one year the cause of death remained unexplained in 61/82 (74%) cases, of which 30 (49%) met the criteria for SIDS, and the remaining were categorized as unclassified due to no investigation of the death scene or that accidental asphyxia could not be ruled out as a cause. In infant cases where voluntary DSI was performed and no explained cause of death established, the criteria for SIDS were met in 27/38 (71%).

A designated manner of death could be established in 102/141 (72%) of the cases (Table 2). The manner of death was determined in 64/75 (85%) of the cases with voluntary DSI, compared to 6/25 (24%) of the cases where DSI was declined or not offered ( $p < 0.001$ , Table 2) and 32/41 (78%, N.S) of the cases investigated by the police. The 39/141 cases with an undetermined manner of death included the 35 cases with unexplained cause that did not fulfill the SIDS or SUDC criteria, such as accidental asphyxia not being ruled out, and 4 cases where asphyxia was established as the cause of death, but where investigations failed to conclude whether death was inflicted or the result of an accident or negligence.

Concerns were raised that neglect or possible abuse could have been a contributory factor to the cause of death in 17/141 (12%) cases. These included cases of drowning while left unsupervised in a bathtub, cases where the caregiver failed to seek medical care despite severe symptoms being present for several days, cases with indications of fatal poisoning and cases that involved finding old rib fractures for which the parents provided no explanation. In seven of these cases it was the voluntary DSI that led to concerns about neglect based on information such as bed sharing with an intoxicated parent or failure to provide proper care.

### **Diagnostic tools most influential for the diagnosis**

We investigated the DSI cases, excluding SIDS and SUDC cases, to determine which tools were most influential in the diagnostic process ((n=34), histology (n=16), medical history (n=14), DSI (n=14) and



gross pathology (n=13)), and found that multiple tools were combined to reach the conclusion in most cases (see Figure 4).

### **Occurrence of known risk factors for infant death obtained by DSI**

Only cases with DSI is included in this part of the study, due to inadequate recording of risk factors in the police cases that made comparison between the two approaches impossible. In DSI cases, 13/28 (46%) of the SIDS victims were found in a prone position, compared to 2/11(18%) with an undetermined cause of death and 2/21(10%) who died from disease (Figure 5). Among children one year and older, 10/13 (77%) of the SUDC victims were found in a prone position, compared to 1/9 (11%) of the children who died of disease ( $p>0.05$ ) (Figure 5). No child older than one year with an undetermined manner of death was found in a prone position. The parents were interviewed about smoking habits as a possible risk factor for SIDS (14). Parental smoking was more common in the undetermined cases 6/11 (55%) and SIDS cases 13/28 (46%) than in infant deaths due to disease 3/12(25%,  $p=0.04$ ). Cotinine was found in 19/55 (35%) of the analysed cases and in 7/19 of these cases the parents had reported that they were nonsmokers. The prevalence of bed sharing did not differ between SIDS victims (32%), undetermined cases (46%) and deaths due to disease (58%). In eight (38%) cases of bed sharing, the children were below 18 weeks old and either one or both parents were smokers.

### **Proportion of police investigations**

The proportion of police examinations of death scenes has varied from 14% in 2011 to 46% in 2014 (Figure 6). The proportion of the cases with voluntary DSI varied between 38% and 58% during the same period. Since about one-fifth of the families did not consent to a voluntary DSI and some other families were not offered a DSI, between 14% and 45% of the death scenes were not investigated (Figure 6).

## **DISCUSSION**

Norway is the only country where the forensic pathologist is a part of the DSI-team in cases with no criminal suspicion. This allows the forensic pathologist to consider the preliminary autopsy findings in the light of information directly provided by the parents. An important finding of the present study is thus that information obtained by the DSI, e.g. the reconstruction of events by a doll, is an essential contribution to the diagnostic work up (Figure 4). A study of the joint agency investigation in England show that one of the elements the parents found most helpful was the information they were provided with during the home visit (15). Norwegian studies also highlight the parents' appreciation of direct contact with the forensic pathologists who had first-hand knowledge of their child's case (13, 16). Garstang and Griffiths (17) have studied the experiences with joint medical and police home visits in England from the professional's perspective, and conclude that all professionals who took part strongly preferred joint home visits to solo police visits. The joint visits presented the enquiries in a medical rather than legal perspective which was less distressing to the parents and did not jeopardise any subsequent potential criminal enquiries.

### **Diagnostic significance of the DSI**

It is presumed that correctly determining the cause and manner of death in itself represents legal protection for the child, parents and others involved in child caring, as it helps the legal system and the community in general to ensure an appropriate end result of the case. It has also been argued that raising awareness about thorough investigations of sudden and unexpected child deaths, by either healthcare personnel or the police, will indirectly protect children by reducing violent behaviour (18).

This study shows that examining the death scene helps to increase the certainty about the diagnosis, as a diagnosis was made in 100/116 (86%) cases in which the death scene was examined (Table 1). This is of particular importance in SIDS and SUDC which are labelled as unexplained deaths. The DSIs contributed in these cases to substantiating the diagnoses by excluding diseases, lesions or

circumstances that could explain a death (10), and by disclosing risk factors . Death scenes examined by the police were more often than DSI-cases concluded with an explained cause of death (Table 1). The police identified 13 cases as accidental asphyxia, compared to 1 in voluntary DSI. The police investigations in these cases took place due to a high suspicion of asphyxia shortly after the death.

Despite the range of diagnostic tools available today, some cases remain unexplained. This also applies when the police investigate the death scene, as indicated by the undetermined cases in the present study (Table 1). However, a markedly higher proportion of cases ended up being undetermined when the death scene had not been investigated, 19/25 cases (76%), than when it had been investigated 16/116 cases (14%), which is a consequence of strictly following the San Diego definition (10). This difference clearly shows that the outcome for many parents would be worse if the death scene is not examined.

Data obtained in the present study indicate that forensic pathologists sometimes diagnose SIDS even when the death scene has not been examined, despite the international definition (10) and agreement about the diagnostic criteria (9). Differences in the conclusions finally drawn might be a result of a variety in experience and personal views regarding the pathology, lesions and circumstances that may cause death (20-22). Consideration about how parents might react to the undetermined diagnosis might also play a role. The study of Garstang et al. highlighted the difficulty in correctly classifying cases of infant deaths (5). They found several deaths that were probably due to unintentional asphyxia but were not labeled as such. These observations are worth considering when evaluating whether DSIs help in diagnosing the cause of death. The increased uncertainty due to the lack of information is why we classified the SIDS cases as undetermined when the death scene was unexamined.

The coding of the death diagnosis in cases with an unsafe sleeping environment is debated internationally. A current international initiative aims to develop diagnostic codes that will make the decisions made by forensic pathologists more consistent (20).

There are some gray-area cases in which it is particularly challenging to determine the correct diagnosis even after performing both a forensic autopsy and DSI, cases where neglect or even abuse is suspected. They are often labeled as undetermined. DSIs can reveal cases with suspected failure of parental care bordering on neglect but which have not crossed the threshold for a criminal act; in such cases this knowledge is important for further following up of the families.

#### **Selection process for cases relevant to DSI**

The proportion of death scenes examined by either the police or through the voluntary DSIs differed during the study period (Figure 6), but the police carried out such examinations in all cases of homicide, neglect, accidents, possible medical malpractice and some gray-area cases diagnosed as undetermined (Table 1). The outcome of the cases show that the selection process for cases relevant to voluntary DSI essentially works according to the intention, that DSI is for cases without criminal suspicion. While the manner of death in 11/75 of the DSI cases was categorized as undetermined, mainly because accidental suffocation could not be ruled out, only 3/11 were reported to the police for further investigations, based on concern about neglect or other failure to provide proper care. The police reopened their investigation in one of them. The remaining 8/11 cases suspected to involve accidental suffocation were not separately reported to the police after the voluntary DSI, as the circumstances were already known to the police. The information relevant to cause of death was instead included in the report given to the police from the forensic autopsy and a part of the final conclusion.

#### **Risk factors for SIDS discovered by DSIs**

The parents are asked to leave the death scene undisturbed prior to DSI. Consistent with Garstang et al. (5) we found that few cases of SIDS and undetermined infant deaths occurred in the absence of environmental risk factors.

We expected to find that a prone sleeping position was more common in toddlers than in young infants (Figure 5). The numbers were significantly lower than during the SIDS epidemic in the 1980s, when more than 90% were found to be prone (23-25). Three of the SIDS victims found prone were younger than 3 months at the time of death and so probably too young to have changed the sleeping position on their own. Hefti et al. (26) found 84% of SUDC victims in prone position and suggested a connection between febrile seizures, a hippocampal malformation, and sudden unexpected death in small children. We do not know if a prone sleeping position was relevant in the cases of children older than one year, but three of them had a history of febrile seizures.

Bed sharing is considered a risk factor for SIDS, even though bed sharing is also found in cases with an explained cause of death (Figure 5). Arnestad et al. found that the prevalence of bed sharing as the usual mode of sleep in their control group increased from 4% in 1984 to 15% in 1998, which was associated with an increase in the number of SIDS victims found dead while co-sleeping with parents (24). This trend of bed sharing has continued in Norway and needs to be explored further in controlled studies. Our study shows that three-quarters of the bed sharing SIDS victims were younger than eight weeks. It remains to be definitely demonstrated whether bed sharing alone is an independent risk factor for SIDS, as was proposed by Carpenter et al. (27). The American Academy of Pediatrics recommends that infants have their own bed that is in the same room as their parents (28). The Norwegian SIDS Society offers the same advice in terms of safe sleeping conditions for infants (29). The risk factors revealed in the present study support this recommendation, at least for the youngest children.

## **CONCLUSION**

From this study it may be concluded that DSIs improve the legal protection of children by obtaining both new and confirmatory information for use in understanding of the cause of death. This is also supported by international studies from England, New Zealand and USA. (17, 30, 31) Since DSI is

voluntary in Norway, there are still cases in which death-scene investigation is not performed (Figure 6), where the police do not consider it necessary or do not have just cause to examine the death scene, or where the parents do not consent to the DSI being performed. The consequence is that important information that could have contributed to establishing the cause of death may be lost.

There is a need for improved methods for investigations and better classifications of sudden and unexpected deaths in infants and children in order to reduce the number of the undetermined gray-area cases (20). Such improvements include making DSIs mandatory.

Even though the total number of cases of SIDS and SUDC has decreased, the proportion of cases involving other manner of death such as acute illness, accidents, neglect and homicide has increased, which makes examinations of the death scene highly relevant. Based on our findings related to the first six years of voluntary DSIs, we conclude that only a mandatory examination of every death scene will ensure that the intentions of DSIs as a legal protection for both children and their caregivers are fully achieved.

#### **LIST OF ABBREVIATIONS**

Death scene investigation (DSI)

Sudden infant death syndrome (SIDS)

Sudden unexplained death in early childhood (SUDC)

#### **ACKNOWLEDGEMENT**

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#### **CONFLICTS OF INTEREST**

The authors performed some of the forensic autopsies and the death-scene investigations evaluated in this article. Other than that, the authors have no conflicts of interest to declare.

#### **FUNDING**

This study did not receive any specific funding.

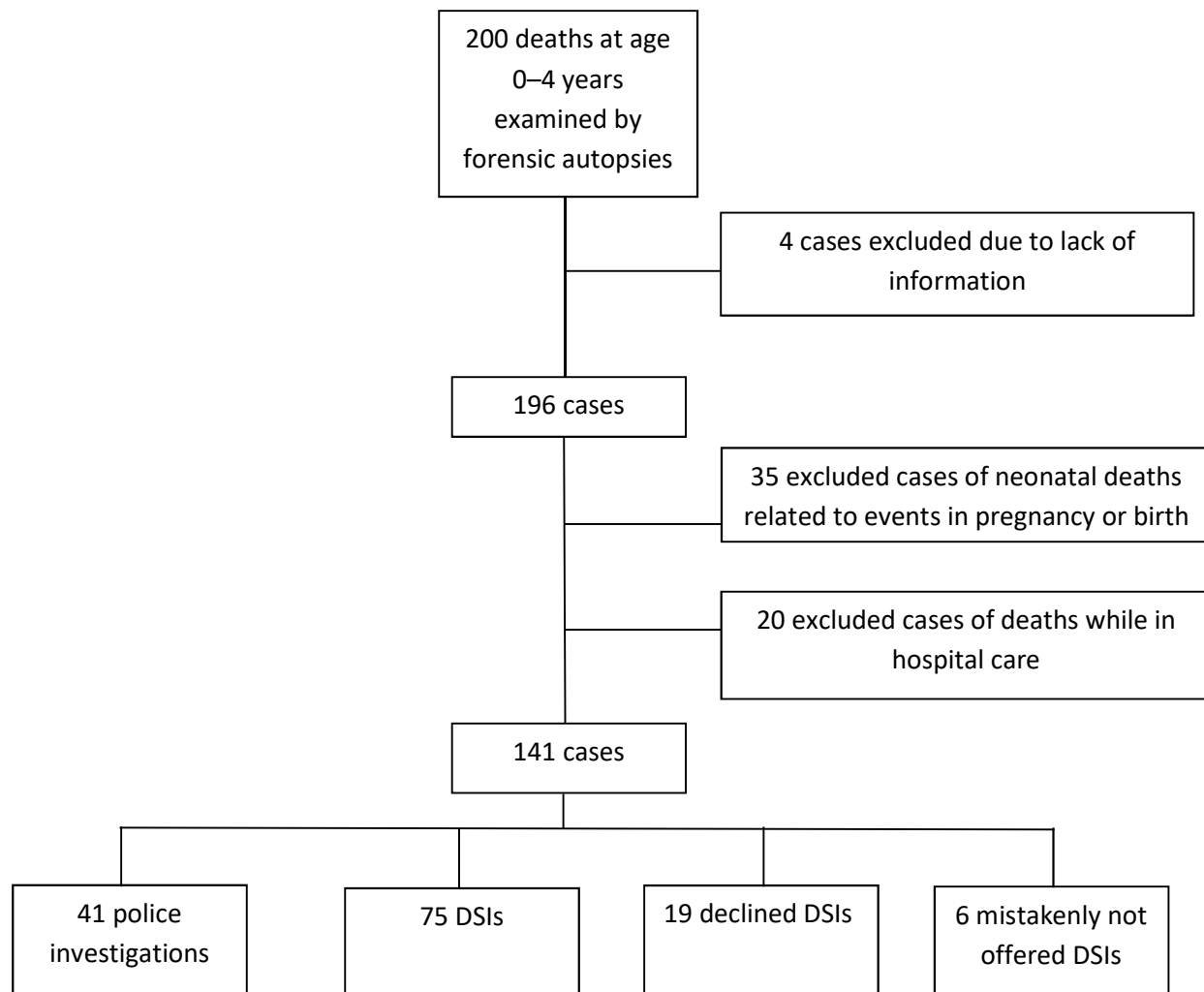
## REFERENCES

1. Guidelines for voluntary death scene investigation. Oslo university hospital; 2016 [updated 2016. Norwegian only]. Available from: <https://oslo-universitetssykehus.no/fag-og-forskning/nasjonale-og-regionale-tjenester/rettsmedisinske-fag/dodsstedsundersokelser/informasjon-til-helsepersonell-om-dodsstedsundersokelser>
2. Circular 2/11 Duty to investigate - children and youth under 18 years old. The Director of Public Prosecutions; 2011[Norwegian only]
3. Fraser J, Sidebotham P, Frederick J, Covington T, Mitchell EA. Learning from child death review in the USA, England, Australia, and New Zealand. *Lancet (London, England)* 2014; 384 9946:894-903 DOI: 10.1016/s0140-6736(13)61089-2.
4. Vincent S. Child Death Review Processes: A Six-Country Comparison. *Child Abuse Review* 2014; 23 2:116-29 DOI: doi:10.1002/car.2276.
5. Garstang J, Ellis C, Griffiths F, Sidebotham P. Unintentional asphyxia, SIDS, and medically explained deaths: a descriptive study of outcomes of child death review (CDR) investigations following sudden unexpected death in infancy. *Forensic Science, Medicine, and Pathology* 2016; 12 4:407-15 DOI: 10.1007/s12024-016-9802-0.
6. Fleming PJ, Blair PSP, Bacon C, Berry PJ. Sudden Unexpected Death in Infancy. The CESDI SUDI Studies 1993-1996: *The Stationary Office, London, 2000.*
7. Byard RW, Rognum TO. Autopsy Findings: Sudden Infant Death Syndrome – Pathological Findings and Autopsy Approach. In: Payne-James J, Byard RW, eds. *Encyclopedia of Forensic and Legal Medicine (Second Edition)*. Oxford: Elsevier, 2016.
8. Gregersen M, Rajs J, Larusen H, Baandrup U, Fredriksen P, Gidlund E, et al. Pathological criteria for the Nordic study of SIDS. Oslo: *Scandinavian University Press, 1995.*
9. Bajanowski T, Vege A, Byard RW, Krous HF, Arnestad M, Bachs L, et al. Sudden infant death syndrome (SIDS)--standardised investigations and classification: recommendations. *Forensic science international* 2007; 165 2-3:129-43 DOI: 10.1016/j.forsciint.2006.05.028.
10. Krous HF BJ, Byard RW, Rognum TO, Bajanowski T, Corey T, et al. . Sudden infant death syndrome and unclassified sudden infant deaths: a definitional and diagnostic approach. *American Academy of Pediatrics* 2004; Jul; 114(1):234-8 DOI: <https://doi.org/10.1542/peds.114.1.234>.
11. Kinney HC, Armstrong DL, Chadwick AE, Crandall LA, Hilbert C, Belliveau RA, et al. Sudden Death in Toddlers Associated with Developmental Abnormalities of the Hippocampus: A Report of Five Cases. *Pediatric and Developmental Pathology* 2007; 10 3:208-23 DOI: 10.2350/06-08-0144.1.
12. Lobmaier IV, Vege A, Gaustad P, Rognum TO. Bacteriological investigation--significance of time lapse after death. *European journal of clinical microbiology & infectious diseases : official publication of the European Society of Clinical Microbiology* 2009; 28 10:1191-8 DOI: 10.1007/s10096-009-0762-0.
13. Heltne UM, Dyregrov A, Dyregrov K. Death scene investigation: parents' experiences. *Scandinavian Journal of Forensic Science (Online)* 2016; 2016;22(2):57-63 DOI: 10.1515/sjfs-2016-0009.
14. Blair PS, Fleming PJ, Bensley D, Smith I, Bacon C, Taylor E, et al. Smoking and the sudden infant death syndrome: results from 1993-5 case-control study for confidential inquiry into stillbirths and deaths in infancy. *BMJ* 1996; 313 7051:195-8 DOI: 10.1136/bmj.313.7051.195.
15. Garstang J, Griffiths F, Sidebotham P. Rigour and Rapport: a qualitative study of parents' and professionals' experiences of joint agency infant death investigation. *BMC pediatrics* 2017; 17 1:48 DOI: 10.1186/s12887-017-0803-2.
16. Kristensen P. Death scene investigation at sudden and unexpected child death. An evaluation study. Oslo: Norwegian Centre for Violence and Traumatic Stress Studies; 2018

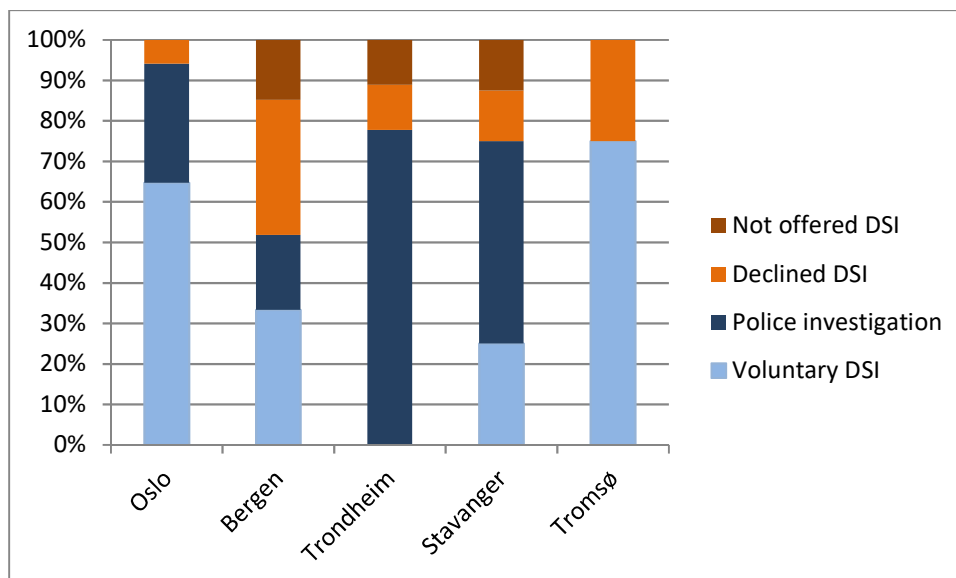


17. Garstang J, Griffiths F. Working Together to Understand Why Infants Die: A Qualitative Study of Professionals' Experiences of Joint Agency Investigation of Sudden Unexpected Death in Infancy: Working Together to Understand Why Infants Die. *Child Abuse Review* 2018; 27 DOI: 10.1002/car.2518.
18. Strandbakken A. Duty to investigate child deaths - a strengthening of childrens legal rights? . *Tidsskrift for familierett, arverett og barnevernrettslige spørsmål* 2011; 9 03/2011:173-5 DOI: <https://doi.org/10.18261/issn.0809-9553>. [ Norwegian only]
19. Rognum TO, L W-S, Arnestad M, A S-P, Vege A. Death scene investigation in sudden death in infant and small children. The Norwegian experiment. *Scand J of Forensic Science* 2010; 1:20-3.
20. Goldstein RD, Blair PS, Sens MA, Shapiro-Mendoza CK, Krous HF, Rognum TO, et al. Inconsistent classification of unexplained sudden deaths in infants and children hinders surveillance, prevention and research: recommendations from The 3rd International Congress on Sudden Infant and Child Death. 2019; DOI: 10.1007/s12024-019-00156-9.
21. Emery JL. Is sudden infant death syndrome a diagnosis? 1989; 299 6710:1240- DOI: 10.1136/bmj.299.6710.1240 %J British Medical Journal.
22. Rognum T. SIDS or not SIDS? Classification problems of sudden infant death syndrome. *Acta Paediatrica* 1996; 85 4:401-3 DOI: 10.1111/j.1651-2227.1996.tb14049.x.
23. Vege A, Rognum TO, Opdal SH. SIDS-changes in the epidemiological pattern in eastern Norway 1984-1996. *Forensic science international* 1998; 93 2-3:155-66.
24. Arnestad M, Andersen M, Vege Å, Rognum TO. Changes in the epidemiological pattern of sudden infant death syndrome in southeast Norway, 1984–1998: implications for future prevention and research. *Archives of Disease in Childhood* 2001; 85 2:108-15 DOI: 10.1136/ad.85.2.108.
25. Markestad T, Skadberg B, Hordvik E, Morild I, Irgens L. Sleeping position and sudden infant death syndrome (SIDS): effect of an intervention programme to avoid prone sleeping. *Acta Paediatrica* 1995; 84 4:375-8 DOI: doi:10.1111/j.1651-2227.1995.tb13653.x.
26. Hefti MM, Kinney HC, Cryan JB, Haas EA, Chadwick AE, Crandall LA, et al. Sudden unexpected death in early childhood: general observations in a series of 151 cases: Part 1 of the investigations of the San Diego SUDC Research Project. *Forensic science, medicine, and pathology* 2016; 12 1:4-13 DOI: 10.1007/s12024-015-9724-2.
27. Carpenter R, McGarvey C, Mitchell EA, Tappin DM, Vennemann MM, Smuk M, et al. Bed sharing when parents do not smoke: is there a risk of SIDS? An individual level analysis of five major case–control studies. 2013; 3 5:e002299 DOI: 10.1136/bmjopen-2012-002299 %J BMJ Open.
28. SIDS and Other Sleep-Related Infant Deaths: Updated 2016 Recommendations for a Safe Infant Sleeping Environment. *Pediatrics* 2016; 138 5:e20162938 DOI: 10.1542/peds.2016-2938.
29. SIDS prevention advice [Internet]. Oslo: The Norwegian SIDS Society; Available from: <https://www.lub.no/forebygging/forebygging-av-krybbedod#la-barnet-sove-i-egen-seng-eller-forsvarlig-samsoving>[Norwegian only]
30. Hutchison B, Rea C, Stewart A, Koelmeyer T, Tipene-Leach D, Mitchell E. Sudden Unexpected Infant Death in Auckland: a retrospective case review. *Acta paediatrica (Oslo, Norway : 1992)* 2011; 100:1108-12 DOI: 10.1111/j.1651-2227.2011.02221.x.
31. Pasquale-Styles MA, Tackitt PL, Schmidt CJ. Infant Death Scene Investigation and the Assessment of Potential Risk Factors for Asphyxia: A Review of 209 Sudden Unexpected Infant Deaths. 2007; 52 4:924-9 DOI: 10.1111/j.1556-4029.2007.00477.x.

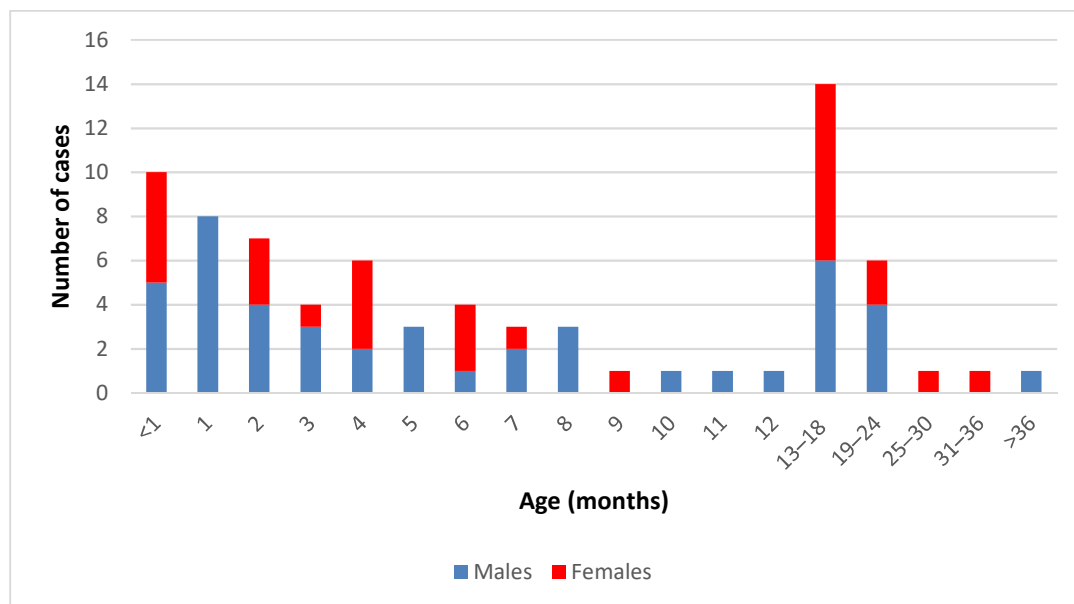
## FIGURES



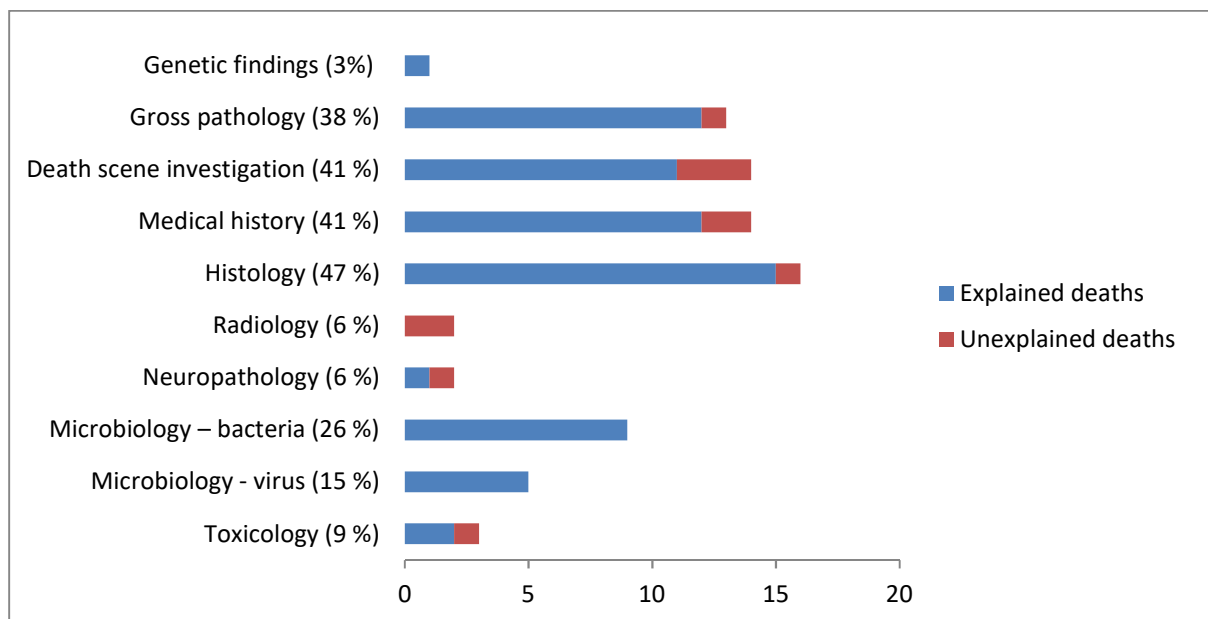
**Figure 1** Flowchart showing case selection. Of the 200 initially identified deaths, 59 cases were excluded due to lack of information ( $n=4$ ), being neonatal deaths ( $n=35$ ) or sudden deaths occurring while in hospital care. The police were responsible for the examinations of the death scene in 41 cases for which they opened full investigations. Voluntary DSIs were performed in 75 cases.



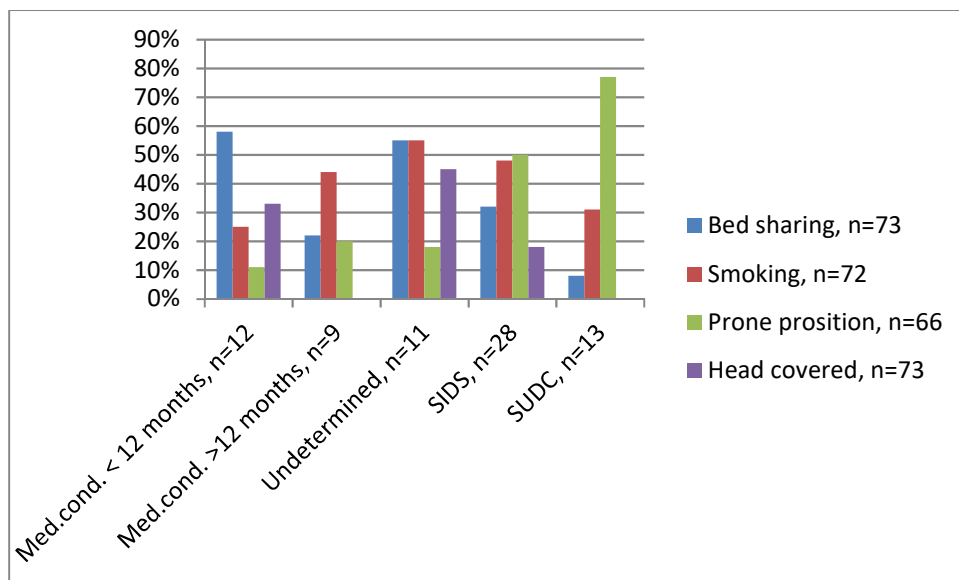
**Figure 2** Sudden infant and early childhood cases (n=141) where an investigation of the death scene was regarded necessary for a reliable diagnosis from November 1, 2010 to December 31, 2016. Each column represents all of the cases in a regional forensic center performing the forensic examinations. The proportions of voluntary DSIs (n=75) and investigations performed by police (n=41) are indicated in light- and dark-blue colours, respectively. In 18% of the cases, the death scene was not investigated by police or the DSI group, due to parents either declining a DSI or not being offered one.



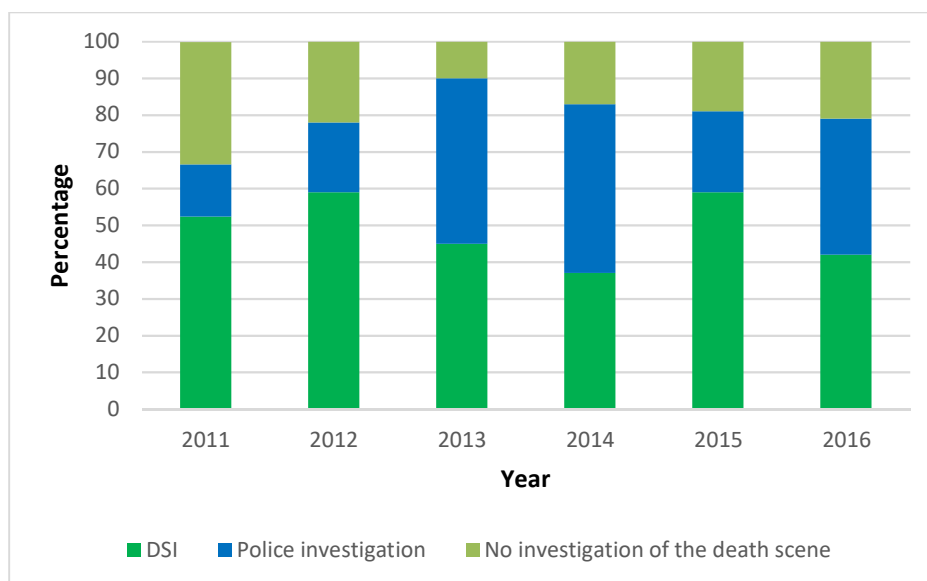
**Figure 3** Age and sex distribution in cases with voluntary DSIs (n=75) from November 1, 2010 to December 31, 2016.



**Figure 4** Diagnostic tools most influential for the diagnosis in 34 DSI-cases with an explained or undetermined cause of death that did not fulfill the criteria for SIDS or SUDC. Several tools contributed to the diagnosis in most cases. In 14 cases the information from the DSI was decisive for the diagnosis process.



**Figure 5** Occurrence of some known risk factors for infant and child death obtained by voluntary DSI performed in Norway from November 1, 2010 to December 31, 2016, divided into explained and unexplained causes of death. Med.cond. refers to death due to a medical condition.



**Figure 6** Changes in the proportions of cases with police investigations and voluntary DSIs in relevant cases (excluding those in which the child died in a hospital) from 2011 to 2016.

**Table 1** Distribution of causes of death in the group of sudden unexpected deaths in children younger than 4 years (n=141). \*Details about causes of death in cases of fatal disease are found in the supplementary appendix.

	Explained deaths				Unexplained deaths		Total
	Medical condition/disease	Violent death/physical injuries	Intoxication	Asphyxia (e.g., suffocation or drowning)	SIDS/SUDC	Undetermined/unclassified	
DSI performed	21* (28%)	0	1 (1%)	1 (1%)	41 (55%)	11 (15%)	75
Declined DSI	4 (21%)	0	0	0	0	15 (79%)	19
DSI mistakenly not offered	2 (33%)	0	0	0	0	4 (67%)	6
Police investigation of death scene	6 (15%)	12 (29%)	0	13 (32%)	5 (12%)	5 (12%)	41
Total	33 (23%)	12 (9%)	1 (1%)	14 (10%)	46 (33%)	35 (25%)	141 (100%)



**Table 2** Distribution of the manner of death in the group of sudden unexpected deaths in children younger than 4 years (n=141). Four cases where asphyxia was established as the cause of death (Table 1) were designated as undetermined, because the investigations failed to conclude whether death was inflicted or the result of accident or negligence. \*Details about causes of death in cases of fatal disease are found in the supplementary appendix.

	Natural		Undetermined	Unnatural			Total
	Medical condition/disease	SIDS/SUDC		Accident	Homicide	Medical malpractice	
DSI performed	21* (28%)	41 (54.7%)	11 (14.6%)	2 (2.7%)	0	0	75
Declined DSI	4 (21%)	0	15 (79%)	0	0	0	19
DSI mistakenly not offered	2 (33%)	0	4 (67%)	0	0	0	6
Police investigation of death scene	6 (14.6%)	5 (12.2%)	9 (22%)	14 (34.2%)	6 (14.6%)	1 (2.4%)	41
Total	33	46	39	16	6	1	141

## **Supplementary appendix on death scene investigation in Norway**

### **Legal basis**

The Norwegian legislation defines all sudden unexpected deaths as “unnatural” if the cause of death is unknown. This is a legal term and does not correspond with the medical use of unnatural deaths. Medical doctors are obligated by the Health Personnel Act section 36 and the Regulation on Medical Practitioners’ Notifications of Deaths section 2, to report each such death to the police. In accordance with the Norwegian Criminal Procedure Act section 224, the police will initiate an investigation. This generally includes ordering a forensic autopsy, based on the Criminal Procedure Act section 228, and is the main rule when children die unexpectedly.

### **The history of the voluntary DSIs**

During the Sudden infant death syndrome (SIDS)-epidemic in the 1980s (1) when the rate reached 0.24 deaths per 1000 live births (2), there were complaints from parents about negative experiences with uniformed police carrying out crime scene investigations and harsh interrogations. The Norwegian SIDS Society, founded in 1986, appealed for a better way of handling these tragic deaths. The Director of Public Prosecutions and the Health authorities agreed in 1991 to withdraw the police from death scenes. Infant and small children who were victims of sudden unexpected deaths should be admitted to the nearest hospital and the families should be followed up by the healthcare. The police were instructed to order a forensic autopsy in all such cases, but they were not allowed to contact families until after the autopsy, and then only if the autopsy revealed suspicions of criminal acts. At the same time, the general healthcare became responsible for following up the families.

During the following decade, according to data from the Norwegian Cause of Death Registry, 387 infants and small children suffered sudden unexpected deaths that were concluded as SIDS or Sudden unexplained death in childhood (SUDC), but only a few of the related death scenes were examined. This practice was not in line with the definitions of the diagnosis SIDS and SUDC.

The Institute of Forensic Medicine at the University of Oslo performed a research pilot study from 2001 to 2004 that introduced voluntary DSIs in southeast Norway (3), and the current nationwide model of DSI is designed in the same way as in that study.

The first sign of the Government's intention to implement DSIs is a proposition to the Norwegian Parliament in September 2007, in which the Government stated that healthcare was to provide a voluntary DSI service for all sudden and unexpected deaths of small children. The Government intended such DSIs to contribute primarily to the diagnosis and secondarily to provide knowledge for the future prevention of sudden unexpected deaths.

The Ministry of Health and Care Services sent the proposition of implementing DSIs on a national hearing in May 2008. The ministry outlined that DSIs should be regarded as caring for the dead children rather than forming part of the healthcare provided to parents. It further proposed that the DSIs should be rooted in pediatric wards with pediatricians leading the teams performing the investigations.

The Standing Committee on Health and Care Services submitted a recommendation to the budget concerning the design of DSIs, and asked the Government to reconsider the qualifications needed in the DSI teams, introducing the need for forensic pathologists. Furthermore, the committee asked the Government to consider making participation in DSIs mandatory for parents.

Based on the results from the hearing and the recommendation from the committee, the Ministry of Health and Care Services concluded in an amendment to the budget that the DSI teams should have expert competence and consist of personnel with interdisciplinary backgrounds, including personnel with education and experience from police investigations, but without current ties to the police, and a forensic pathologist.

The Ministry of Justice was asked for advice regarding mandatory DSIs. The Legislation Department concluded that making DSIs mandatory in cases with no suspicion of a criminal act might not be in accordance with the Norwegian Constitution section 102 and article 8 of the European

Convention on Human Rights, which are both related to respect for the private life and family life of citizens (4). The Government decided on these grounds that DSIs should be performed as voluntary healthcare and that informed consent would need to be obtained from the parents in every case.

The final decision about DSIs is described in a letter from the Ministry of Health and Care Services dated in June 2009, where the following main elements were presented as a framework: The purpose of a DSI is to contribute to determining the cause of death, to provide legal protection, and the prevention of future deaths. DSI should only be performed in cases with no suspicion of a criminal act. DSI is voluntary and dependent on obtaining informed consent from the parents. The investigation should take place after performance of the forensic autopsy and possibly within 48 hours after the time of death. The DSI team is to consist of the forensic pathologist that had done the autopsy and a police expert.

The Norwegian Institute of Public Health prepared guidelines based on these conditions, which the current practice still follows (5).

### **The police decide between a pure police investigation and a voluntary DSI as healthcare**

Eight months after the implementation of DSIs as a voluntary healthcare service, the Criminal Procedure Act section 224 was modified to instruct the police to initiate investigations in all cases of sudden and unexpected death of a child, up to the age of 18 years, independent of any suspicion of a criminal act. By this amendment the Parliaments wished to underline the importance of disclosing cases of abuse and violence against children, and to strengthen the quality of the investigations of sudden and unexpected child deaths.

An important aspect of this new investigative duty for the police is that the government did not follow up with legislative changes regarding the use of coercive measures, such as to conduct searches of private homes. The Criminal Procedure Act section 192 requires *just cause* in order to use coercive measures. Just cause is considered to be present when it is estimated that it is more than 50% likely that a criminal act has been committed. Just cause can be challenging to consider in cases

of sudden infant deaths, at least in the initial phase. The child is most often brought to the nearest hospital while undergoing resuscitation attempts, resulting that when the police are notified, the death scene is changed. Furthermore, sudden unexpected child deaths are often not witnessed and typically occur during sleep. This means that the police can be in a situation with little information about the events.

This makes a thorough forensic autopsy a crucial part of the police investigation. An autopsy allows the forensic pathologist to identify underlying medical conditions, injuries, or the presence of intoxication. However in many cases, a forensic autopsy cannot provide a complete explanation of the fatal event (6). For example, revealing the risk of suffocation, overlaying, or overheating requires the death scene to be examined. Without the appropriate legislative grounds to conduct a search, without just cause, the police can only enter the house to examine the death scene with consent from the parents.

### **DSI guidelines**

Most infants who die suddenly and unexpectedly are found lifeless in their family homes and when the emergency personnel arrive they start resuscitation unless death has already been clearly recognized. If death is confirmed prior to transportation, it is common practice that the child is brought by ambulance to the nearest hospital with a pediatric ward.

The police will normally order a forensic autopsy. Depending on the outcome of the preliminary investigation, the police either will continue to a thorough investigation if a criminal act is suspected or postpone investigation pending the final forensic autopsy report. Cases in which there is no suspicion of a criminal act are open to proceeding with a voluntary DSI (5, 7).

After receiving written consent and in agreement with the police, the pediatrician contacts the DSI team who then establishes a direct link with the parents. The forensic pathologist who

performed the autopsy carries out the DSI together with a police expert employed by the forensics department.

Both the autopsy and DSI need to be completed within 48 hours after the time of death, and the autopsy has to be performed before the DSI in order to compare preliminary findings from the autopsy with the DSI findings. This short time limit is designed to ensure the validity of microbiological testing (8) and also provides the parents with relevant information at an early stage in the grief process (9).

The DSI starts out by interviewing the parents in order to collect information about the child and the household, including the child's and parents' medical histories, pregnancy, birth, prematurity, information concerning the newborn period, the parental consumption of nicotine, alcohol and drugs, and most importantly, the circumstances around the time that the child was found dead/lifeless.

The DSI then proceeds with an examination of the death scene, including a reconstruction of the event. The child's sleeping environment is reviewed for possible traces of blood, vomit, or bloody foam in the bed, loose objects in which the child could potentially have become entangled, whether the linen was made from airtight material, the estimated softness of the mattress and the thickness and weight of the duvet, and the room temperature. The examination is performed while considering known risk factors, such as sleeping in a prone position and sharing the same sleeping surface as either one or both parents. Special hand-made dolls are used to reconstruct the position when the child was laid down to sleep and the position that the child was in when found dead or lifeless. The doll is chosen to match the child's age and weight. The parents use the doll to explain and show the different positions adopted by the child. The reconstruction is photographed for documentation purposes. Preliminary findings from the autopsy are compared with the information obtained at the death scene.

Finally, the parents are provided with information about the preliminary findings from the autopsy and may ask questions to the forensic pathologist who performed the autopsy.

The report from the DSI becomes a part of the medical record of the child. When the autopsy, including all additional tests, is completed and the forensic pathologist has submitted a final autopsy report, an interdisciplinary case conference is held to discuss and conclude each case. Cases with obvious suspicion of a criminal act are not discussed. In addition to the forensic pathologist who performed the autopsy and is responsible for the final forensic report, plus the police expert who participated in the DSI, the medical staff who were involved in the handling of the child and the diagnostic workup are invited to participate. Typical attendants include the emergency doctor, consulting pediatrician, pediatric radiologist, neuropathologist, microbiologist, and forensic toxicologist. The evidence for the final diagnosis, the diagnostic tools that contributed significantly to the diagnosis and the important question about whether the death could have been prevented are discussed. If the conclusion of the interdisciplinary case conference differs significantly from the diagnosis and the conclusions drawn in the autopsy report, an additional report is submitted by the forensic pathologist with an amended conclusion. The goal of the case conference is to achieve interdisciplinary agreement regarding the cause of death.

**Table 3** Details about causes of death in the 21 cases with death scene investigation concluded with fatal disease.

<b>Mode/Cause of death</b>	<b>n</b>
<b>SIDS/SUDC</b>	<b>41</b>
<b>Disease</b>	<b>21</b>
<i>Heart and lung disease (including malformations)</i>	6
<i>Pneumonia</i>	2
<i>Pneumonia/ congenital malformation</i>	3
<i>Septicemia</i>	5
<i>Congenital metabolic disorder (MCAD- deficiency)</i>	1
<i>Intussusception/ volvulus</i>	2
<i>Brain malformation</i>	1
<i>Asphyxia/ malformation</i>	1
<i>Cerebral hypoxia/ premature</i>	1
<b>Accident</b>	<b>2</b>
<b>Undetermined</b>	<b>11</b>



1. Rognum TO, Lier LA. Police investigation and SIDS: An improved system of cooperation between health personnel, forensic pathologists, and the police? In: *Sudden Infant Death syndrome - New trends in the nineties*. Ed Rognum TO. Oslo: Scandinavian University Press 1995
2. Vege A, Rognum TO, Opdal SH. SIDS-changes in the epidemiological pattern in eastern Norway 1984-1996. *Forensic science international* 1998; 93 2-3:155-66.
3. Rognum TO, Wille-Sveum L, Arnestad M, Stray-Pedersen A, Vege A. Death scene investigation in sudden death in infant and small children. The Norwegian experiment. *Scand J of Forens Sci*. 2010; 16:20-3.
4. Death scene investigations of sudden and unexpected child death - the relationship with the Constitution § 102 and ECHR article 8. (Norwegian only). Ministry of Justice and Public Security 2009
5. Guidelines for voluntary death scene investigation. Oslo university hospital 2016
6. Byard RW, Rognum TO. Autopsy Findings: Sudden infant death syndrome – Pathological findings and autopsy approach. In: *Encyclopedia of forensic and legal medicine (second edition)*. Eds Payne-James J, Byard RW. Oxford: Elsevier, 2016.
7. Circular 2/11 Duty to investigate - children and youth under 18 years old. The Norwegian Director of Public Prosecutions 2011
8. Lobmaier IV, Vege A, Gaustad P, Rognum TO. Bacteriological investigation--significance of time lapse after death. *European journal of clinical microbiology & infectious diseases : official publication of the European Society of Clinical Microbiology* 2009; 28 10:1191-8 DOI: 10.1007/s10096-009-0762-0.
9. Heltne UM, Dyregrov A, Dyregrov K. Death scene investigation: parents' experiences. *Scandinavian Journal of Forensic Science (Online)* 2016; 2016;22(2):57-63 DOI: 10.1515/sjfs-2016-0009.