

# Surveillance of injury-related deaths: medicolegal autopsy rates and trends in Finland

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Medicolegal autopsies are a vital tool for obtaining reliable injury mortality data. In Finland, medicolegal autopsies have increased from 13.6% of all deaths in 1970 to 23.8% in 2004. In fact, medicolegal autopsies are performed in 87.2% of all unintentional injury deaths, 98.3% of homicides and 99.5% of suicides. Finland has exceedingly high medicolegal autopsy rates compared with other countries. Autopsy rates should be appropriately considered when performing international comparisons of injury-related deaths.

Mortality statistics, in high-income countries, are based on cause of death certificates in >99% of cases.<sup>1</sup> The validity and reliability of mortality statistics depend critically on how accurately death certification measures the causes of death at population level.<sup>2</sup> The accuracy of death certification, in turn, relies on the quality of postmortem investigations, the quality of data compiled for each death and the coding procedures during the registration process.<sup>3</sup> Together with medical history, clinical information and investigation into the circumstances of deaths, autopsy represents the best source of information for determining the cause of death.

## MATERIALS AND METHODS

Nationwide mortality data based on the International Classification of Diseases 10th revision<sup>4</sup> and data on the method used for determining the cause of death, 2000–3, were provided by Statistics Finland (SF) and used to determine the medicolegal and clinical autopsy rates, by age, sex, manner and cause of death, province, county and site of death. Another dataset from SF was used to investigate the time trends in autopsy rates from 1970 to 2004. According to Finnish law, a medicolegal investigation into the cause of death should be performed when death is caused or suspected to be caused by crime, accident, suicide, poisoning, occupational disease or medical treatment, when death has not been caused by a disease or when during the last illness the deceased had not been treated by a doctor, and when death is otherwise unexpected. The consent of the victim's next of kin is not required. Conversely, a clinical autopsy can be performed on the request of the doctor in charge of the patient and with the consent of the deceased's family, for instance, to determine the exact nature of a disease, its extension and the effects of treatment.

## RESULTS

### Medicolegal and clinical autopsy 2000–3

Altogether, 196 242 deaths occurred in Finland during 2000–3. Of these, 41 472 (21.1%) underwent a medicolegal autopsy and 17 919 (9.1%) a clinical autopsy. The remaining cases (69.8%) were certified on the basis of either clinical data or a certificate of death issued abroad.

Among the 17 079 injury deaths, 15 417 (90.3%) underwent a medicolegal autopsy, 1530 (9.0%) were certified on the basis of clinical data, 65 (0.4%) were certified on the basis of a clinical autopsy and 65 (0.4%) were certified on the basis of a cause of death certificate issued abroad. In two cases the certificate of death was not available to SF. The percentage of medicolegal autopsies was constantly >97% in age groups up to 64 years, but decreased to <60% for those aged >80 years. Conversely, among the 371 injury deaths in children and adolescents aged <18 years, 367 (98.9%) cases underwent a medicolegal autopsy.

The percentage of medicolegal autopsies also varied according to the manner of death, from 87.2% in unintentional injury deaths to 99.5% in suicides (table 1). Among unintentional injury deaths, the medicolegal autopsy rate was >98% for deaths due to poisonings, traffic accidents, electrocution, fire or hypothermia, whereas it was <70% for fall-related deaths.

Finland is divided into 6 provinces and 20 counties. As for geographical differences, the percentage of medicolegal autopsies in injury deaths varied from 80% in the low-populated Åland province to 91.2% in Oulu province. Across the 20 administrative counties, the overall percentage of medicolegal autopsies in injury death was >90% in 9 counties, whereas none had a percentage <80%.

Although the overwhelming majority of injury deaths occurring at home or in a public place underwent a medicolegal autopsy (99.6% and 98.2%, respectively), for injury deaths occurring in hospitals or health centers, the percentage of all ages fell to 73.4%.

### Time-trends 1970–2004

During the 1970s, and until the beginning of the 1980s, total autopsy rates increased due to an increase in both clinical and medicolegal autopsy rates, and reached a peak of 38% in 1982. Since the first half of the 1980s, the total autopsy rate slightly decreased, due to a substantial decrease in clinical autopsy rates associated with a clear upward trend of medicolegal autopsies. During 1970–2004, clinical autopsy rates showed a remarkable decline from 18.8% of all deaths in 1970 to 8.3% in 2004. Conversely, medicolegal autopsy rates increased from 13.6% in 1970 to 23.8% in 2004 (fig 1).

Concerning natural deaths, the overall autopsy rates ranged from 28.4% in 1970 to 27.2% in 2004. Medicolegal autopsy rates increased more than twofold, from 8.1% in 1970 to 18.1% in 2004, whereas during the same period clinical autopsies dropped to less than half, from 20.3% to 9.0% in 2004.

With regard to injury deaths, the overall autopsy rates ranged from 75.9% in 1970 to 88.9% in 2004. Medicolegal autopsy rates ranged from 73.0% in 1970 to 88.7% in 2004. Clinical autopsy rates ranged from 2.9% in 1970 to 0.2% in 2004, and were constantly <1% since 1994.

Abbreviation: SF, Statistics Finland

**Table 1** Injury deaths in Finland 2000–3: method used for the determination of cause of death, by manner of death

	Medicolegal autopsy n (%)	Clinical data n (%)	Clinical autopsy n (%)	Certificate of death abroad n (%)	Total n (%)
Unintentional	9851 (87.2)	1347 (11.9)	58 (0.5)	40 (0.4)	11 296 (100.0)
Suicide	4520 (99.5)	7 (0.2)	1	13 (0.3)	4541 (100.0)
Homicide	515 (98.3)	1 (0.2)	0	8 (1.5)	524 (100.0)
Undetermined	401 (96.9)	6 (1.4)	1 (0.2)	4 (1.0)	414 (100.0)
Other	6 (40.0)	9 (60.0)	0	0	15 (100.0)
All injury	15 417 (90.3)	1530 (9.0)	65 (0.4)	65 (0.4)	17 079 (100.0)

In two cases (undetermined deaths), the certificate of cause of death was not available.

## DISCUSSION

Clinical and medicolegal autopsies have foremost importance for accurate evaluation of single deaths and correct medical certification of cause of death. Circumstances and external body examination alone in no way provide reliable information for the determination of cause of death. As in trauma-related deaths, for instance, the underlying cause of death in a body found in water is not always submersion, but can be a natural condition or a trauma sustained while in water or causing the victim to fall into water, and, although traffic accident victims may have major external injuries, autopsy can reveal a natural condition (eg, myocardial infarct, intracerebral hemorrhages), which may explain the crash dynamic. Moreover, an autopsy can allow the identification of internal lethal injuries when external body examination reveals no major trauma or when no or minor clinical symptoms are reported before death. In apparent natural deaths, postmortem toxicology allows the diagnosis of alcohol, drug or intoxication by other substances.

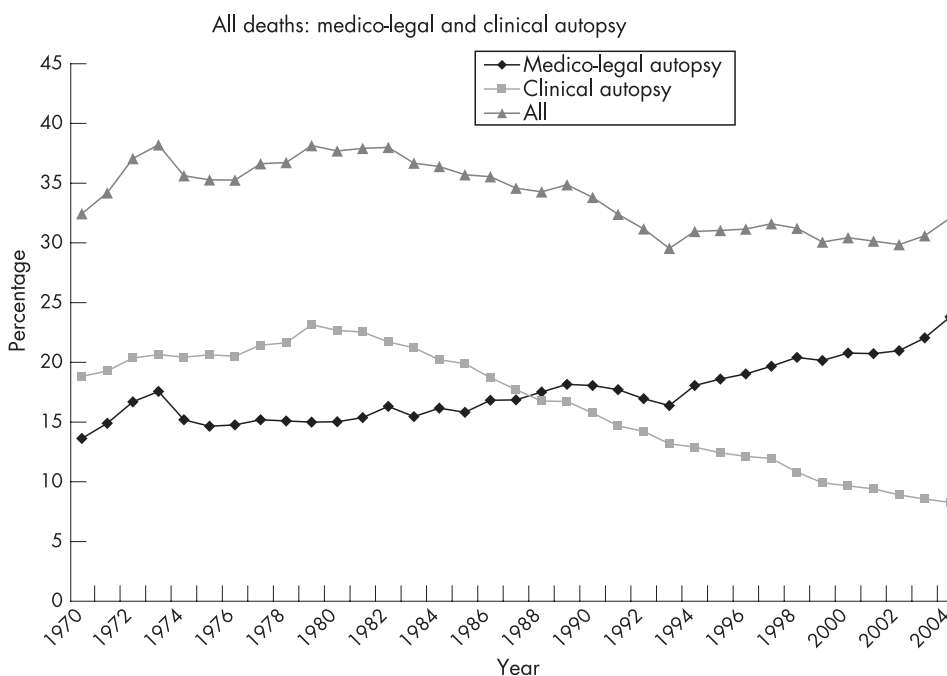
Autopsy-based data have important legal implications, are cost effective for medical education, provide quality assurance and control for medical care, and provide new insights into the pathogenesis of disease and injury mechanisms.<sup>5–7</sup> Data obtained from autopsy also allow the assessment of more specific issues, which may have noteworthy implications for

prevention, such as the actual rate of infant injury deaths, which are misdiagnosed as sudden infant death syndrome, or the actual risk of unnatural deaths in individuals with acquired or congenital diseases.<sup>8–10</sup>

Although it has been repeatedly stressed how different coding procedures may hamper the international comparability of injury-related deaths,<sup>11</sup> much less attention has been paid to the variation of autopsy rates between countries. The World Health Organization's general data show a wide variation in autopsy practices among countries,<sup>1</sup> but detailed data on autopsy rates at national level are scarce.

Countries with low autopsy rates may show a deceptive underestimation of selected causes of unintentional or violent deaths, ranging from poisonings to fatal trauma with minor external injuries, as well as completely misleading data on alcohol involvement in injury deaths. In Germany, more than 1200 homicides and 11 000 unnatural deaths are undetected annually due to low autopsy rates,<sup>12</sup> and in Nordic countries the number of deaths assigned to ICD category "Symptoms, Signs, and Ill-defined conditions" is inversely proportional to the autopsy rate.<sup>13</sup>

Autopsy rates have declined during the past decades in many high-income countries,<sup>13–19</sup> especially as a consequence of the decline in clinical autopsy. This negative trend has been

**Figure 1** Medicolegal and clinical autopsy rates (%) for all deaths, Finland 1970–2004.

explained by various reasons such as increasing costs, lack of medical education, development of new clinical diagnostic tools, medical malpractice implications and difficulties in obtaining permission from relatives.<sup>7, 20</sup> In the US, the overall autopsy rates declined from about 17% to 9% during the 1980s and 1990s,<sup>14, 15</sup> a period during which medicolegal autopsies were steadily performed, but only in about 4% of all deaths. The autopsy rate for trauma deaths was about 50–60%, with wide interstate variation (10–95%). In Germany, during the 1990s, the percentage of clinical autopsies decreased from about 4% to 3%. Conversely, medicolegal autopsies remained stable at about 2%, but interstate differences were up to fivefold.<sup>16</sup> In Sweden, clinical autopsies declined from approximately 39% in 1970 to 16% in 1993, whereas the percentage of medicolegal autopsy dropped from 13–14% during the 1980s to 6% during the 1990s.<sup>13, 17</sup> In Denmark, clinical autopsies declined from 45% in 1970 to 16% at the end of 1990,<sup>19</sup> whereas medicolegal autopsies were approximately 2.5% in 1992.<sup>13</sup>

In Finland, during the 1960s, the overall autopsy rate was 14.2% and provincial variations were high, from 2.8% to 37.8%.<sup>21</sup> In the beginning of the 1970s, the overall autopsy rate increased and reached a high of 38.3% in 1973. During the 1980s, Finnish autopsy rates experienced a downward trend, similar to other countries, mainly due to a decline in clinical autopsy. However, medicolegal autopsy rates have increased more compared with other countries, for reasons including the implementation of the Finnish medicolegal system, the increased awareness of patients' right in medical practice and the ageing of the Finnish population, with an increasing number of sudden out-of-hospital deaths. The Finnish legislation underlying medicolegal autopsy does not focus exclusively on alleged injury deaths and allows medicolegal autopsy to be performed without consent from the relatives of the deceased.<sup>19</sup>

Medicolegal autopsies, mostly inclusive of toxicological analysis, actually cover approximately 90% of injury deaths and up to 10–15% of natural deaths. This markedly reduces the risk of misdiagnosis of injury or intoxication deaths as natural deaths. The relatively low medicolegal autopsy rates among elderly people reflect the high number of fall-related deaths, which occur especially in healthcare centers after prolonged hospitalization and for which clinical data are generally known to the doctors.

The value of medicolegal autopsy for mortality statistics is strengthened by the high rate of postmortem toxicology, the validation procedures of the cause-of-death certificate, and the fact that the latter is issued only after the completion of the autopsy and all accessory investigations.<sup>2, 22</sup> In 2005, the total budget for all medicolegal autopsies performed in the whole

country was €7 335 000 (US\$9 942 210.49, £4 971 938.55), including toxicological and histological investigations.

In conclusion, adequate information on injury mortality in great demand worldwide for developing and implementing public health interventions. A crucial preliminary key towards improvement of surveillance data is the precise determination of the cause(s) of death and contributing factors, which can be obtained only by full autopsy and complementary investigations. Legislative measures aiming to strengthen medicolegal systems and providing a strong framework for the practice of medicolegal autopsy improve the reliability of injury mortality data, especially when autopsy results are directly or retrospectively connected to vital statistics.

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#### Key points

- Medicolegal autopsies are a crucial tool for assessing injury-related deaths and for obtaining reliable mortality data.
- Finland has exceedingly high medicolegal autopsy rates compared with other high-income countries.
- During 1970–2004, the medicolegal autopsy rates have increased in Finland from 13.6% to 23.8% of all deaths.
- The overall autopsy rate for injury deaths was >97% among age groups up to 64 years.
- Autopsy rates must be appropriately considered when performing international comparisons of injury-related deaths.