



Cost–consequence analysis of cause of death investigation in Finland and in Denmark



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ABSTRACT

The 1990s 12–16% total autopsy rate in Denmark has until now declined to 4%, while in Finland, it has remained between 25 and 30%. The decision to proceed with a forensic autopsy is based on national legislation, but it can be assumed that the financing of autopsies influences the decision process. Only little is known about the possible differences between health economics of Finnish and Danish cause of death investigation systems.

The aims of this article were to analyse costs and consequences of Finnish and Danish cause of death investigations, and to develop an alternative autopsy practice in Denmark with another cost profile.

Data on cause of death investigation systems and costs were derived from Departments of Forensic Medicine, Departments of Pathology, and the National Police. Finnish and Danish autopsy rates were calculated in unnatural (accident, suicide, homicide and undetermined intent) and natural (disease) deaths, and used to develop an alternative autopsy practice in Denmark. Consequences for society were analysed.

The estimated unit cost (€) for one forensic autopsy is 3.2 times lower in Finland than in Denmark (€1400 versus €4420), but in Finland the salaries for forensic pathologists working at the National Institute for Health and Welfare are not included in the unit cost. The unit cost for one medical autopsy is also lower in Finland than in Denmark; €700 versus €1070. In our alternative practice in Denmark, the forensic autopsy rate was increased from 2.2% to 8.5%, and the medical autopsy rate from 2.4% to 5.8%. Costs per 10,000 deaths were estimated to be 50% ($\pm 25\%$) higher than now; i.e. €3,678,724 (2,759,112–4,598,336), but would result in a lower unit cost for forensic autopsies €3,094 (2,320–3,868) and for medical autopsies €749 (562–936). This practice would produce a higher accuracy of national mortality statistics, which, consequently, would entail higher quality in public health, an accurate basis for decision-making in health politics, and better legislative safety in society.

The implementation of this alternative practice in Denmark requires that legislation demands that forensic autopsy be performed if causality between unnatural death and cause of death cannot be clarified or if cause of death remains unknown. The Danish Health and Medicines Authority should provide guidelines that request a medical autopsy in natural deaths where more information about disease as a cause of death is needed. Our study results warrant similar health economic analyses of different cause of death investigations in other countries.

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1. Introduction

Although it is well known that an autopsy provides accurate information on cause of death (CoD) and manner of death (MoD) [1–11], national legislation and practice governing cause of death investigation (CoDinv) differ in Finland (FI) [12] and Denmark (DK) [13], as seen by a high autopsy rate in FI and a low autopsy rate in DK [14,15]. The decision to proceed with a forensic autopsy in medico-legal CoDinv is based on legislation, but it can be assumed that the financing of the system influences the decision process, although both FI and DK use national CoD statistics to guide public health politics and legislative safety in society.

In DK, the police pay for the forensic autopsies and cadaver transport via their annual, police district budgets [13]. Although annual budgets are based on the estimated costs of different aspects of police work, e.g. forensic autopsies, the final decision on how to spend the money is made by the police in the individual districts. The costs for forensic autopsies hence compete with other costs in the police district, e.g. investment in new equipment necessary to perform police work. In FI, the government finances forensic autopsies, and these do not compete with other costs. The police are responsible for paying for cadaver transport, but this cost is refunded to the police by the government's central administration [12].

Finnish and Danish legislation governing CoDinv use medico-legal investigation in suspected unnatural deaths (accident, suicide, homicide, or undetermined intent), and medical investigation in deaths caused by disease [12,13]. In both countries, the police are responsible for the medico-legal CoDinv. Finnish legislation demands that a forensic autopsy be performed in deaths due to an unnatural MoD or if the CoD remains unclear after police investigation [12]. Forensic autopsy is also performed in cases where the CoD remains unclear but the death is classified as natural. Unnatural deaths where police investigation does not proceed with a forensic autopsy are usually cases in which the CoD is obvious and toxicological investigations would not be informative, e.g. when elderly patients die at the hospital due to pneumonia a few days after surgical treatment of an accidental hip fracture, or when patients die at the hospital because of injuries caused by an accident. In DK, legislation demands that external forensic examination of the body be performed in case of violent deaths or deaths suspected of being unnatural. Investigation proceeds with a forensic autopsy only if the MoD is uncertain, if a crime is suspected, or if the case is otherwise of interest to the police [13].

DK did not always have a low autopsy rate: in 1990, Danish legislation changed which meant that permission from the next-of-kin must be granted to perform an autopsy. The total autopsy rate consequently decreased from 22% to 16% during a 12-month period [16]. In 1996, the total autopsy rate declined further from 16% to 12.5% of all deaths and on Danish annual publication of CoDs was concluded that the increase in the proportion of deaths classified without a specific CoD is due to the low total autopsy rate [17]. This decrease was mainly caused by a decrease in the medical autopsy rate as the forensic autopsy rate has always been low in DK. In the period 1991–1996, about 2.5–3% of total deaths were investigated with a forensic autopsy. Even though forensic pathology has been an accepted medical specialty in DK since 2008, the forensic autopsy rate has decreased; at the moment, the forensic autopsy rate is about 1.5%, and the total autopsy rate is 4% of total deaths.

Our previous study has shown [18] that DK has a significantly high number of ill-defined and unknown CoDs where CoDinv does not include a forensic autopsy. More than 80% of these Danish deaths were over 70 years of age at the time of death. The same study found that only few yearly deaths are registered with an

unknown CoD in FI, and all these deaths were investigated using a forensic autopsy. We have also shown [19] that the autopsy rate in suicide is low among elderly in DK (5.6%) compared with FI (99.6%), and that the autopsy rate was 89.5% among Danish deaths due to poisoning when these deaths were classified as accidents, but only 20.7% for cases classified as suicides.

Although cost–consequence analysis (CCA) is an important tool in health economics and of particular interest to public health care interventions, it has rarely being used to analyse the impact of CoDinv system to society [20,21]. To the best of our knowledge, no studies have previously assessed the costs and compared the consequences of different existing national CoDinv systems. In addition, we are unaware of the existence of studies exploring an alternative autopsy practice and its costs and consequences in society.

Thus, the aims of the present study were to analyse characteristics and costs of existing CoDinv systems in FI and in DK, and to develop an alternative autopsy practice in DK with a higher autopsy rate and therefore another autopsy cost profile.

2. Materials and methods

2.1. Characteristics of CoD investigation systems in FI and DK

Data on the number of Regional Forensic Centers in FI and University Departments of Forensic Medicine (UNI Dep FM) in DK, and the number of forensic pathologists and trainees working there were extracted from internet pages of Forensic Medicine Units in the National Institute for Health and Welfare (NIFHW) in FI and the UNI Dep FMs in Copenhagen, Odense and Aarhus in DK. Regional Forensic Centers in FI include both NIFHW and UNI Dep FMs, which are working in the same building [22]. Data on the average number of annual Finnish forensic autopsies were obtained from the Finnish NIFHW Internet page. Data on the average number of annual Danish forensic autopsies and external forensic examinations were obtained from the three UNI Dep FMs and from some of the Institutes of Public Health Medical Officers. Data on the average annual number of medical autopsies were obtained from the Departments of Pathology in FI and in DK.

Cost assessment: Costs were defined as the total financial costs (including overhead and cadaver transport). Data on costs were taken from 2012–2013 budgets of Regional Forensic Centers in FI, UNI Dep FMs in DK, Departments of Pathology in FI and DK, and the National Police in FI and DK. Estimates of total costs and unit costs (average cost per autopsy and cadaver transport) were calculated in collaboration with these organizations and departments. All costs are estimated in national currencies and converted from Danish krone (DKK) into Euros (exchanges rate 2014; DKK7.46 = €1).

2.1.1. Existing autopsy rates in FI and in DK

Information from the death certificates was extracted from the mortality registries for 2010. Data from FI covered 90% of all deceased persons who died after four weeks of age. The 10% random exclusion is due to Finnish legislation [12,23,24], which prohibits the use of all deaths in FI at the same time period for research purposes. Simple randomization was performed in Statistics Finland using SAS (Statistical Analysis Software). Data from DK covered all deaths in 2010. To enable a valid comparison, we excluded all deaths occurring before one year of age in both countries. All statistical analyses were conducted using IBM SPSS Statistics software (Statistical Package for the Social Sciences, version 20).

Finnish deaths were divided into eight MoDs according to the Finnish classification (disease, occupational diseases, accident, medical treatment or examination, suicide, homicide, war, and

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