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LETTER TO THE EDITOR

The slow death of autopsies: a retrospective analysis of the autopsy prevalence rate in Austria from 1990 to 2009

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Autopsies are still the gold standard by which treatment methods, clinical decision-making procedures and diagnostic tools can be measured. They not only help to establish the true cause of death, they also provide an insight into how patients' deaths can be prevented in future.

In Austria, where autopsy enjoyed its apotheosis in the 1800s, the law permits non-forensic autopsies to be done without the consent of next of kin in cases in which there is a clear medical or scientific interest. Autopsy rate reporting may vary between institutions, depending on whether forensic, other outpatient cases, stillbirth cases, and cases referred from outside the hospital are included; many of the rates are reported from individual hospitals and appear in published studies.

This study is unique in the literature due to the fact that it is based on a huge data set containing individual information for every single person deceased in Austria between 1990 and 2009. Our data provided by "Statistics Austria" [1] include: status and kind of autopsies (medicolegal, clinico-pathological, others), sex, religion, family status, province, nationality, institution/place and date of death, age of deceased in years. The effect of the interesting variables as well as their interaction terms on the autopsy was estimated by a logistic regression model. 95 % confidence intervals are given in brackets.The autopsy prevalence rate for the 1.565.151 cases with no missing values in the explanatory variables during the observation period decreased from 34.2 % (33.8, 34.5) in 1990 to 17.5 % in 2009 (17.3, 17.8).

Between 2004 and 2009 the frequency of clinico-pathological autopsies decreased from 18.2 % (18.0, 18.5) to 14.4 % (14.2, 14.6) of all deaths. The medicolegal autopsy prevalence rate remained stable on a low level at about 1.5 %.

All variables in the regression model turned out to be significant ($p < 0.01$). Table 1 presents odds ratios (OR) for all variables that do not include an interaction term with "year of death".

The probability of autopsy is highest among persons with unknown religious affiliation with an OR of 1.21 compared to the reference group Roman Catholic. In contrast Jews demonstrate the lowest autopsy prevalence rate with an OR of 0.28.

Foreigners have a slightly higher probability of post mortem examinations with an OR of 1.04 compared to Austrians.

The probability of autopsy is higher among singles, widowed and divorced people compared to married couples. Divorced people display the highest OR with a value of 1.42.

Persons dying in a rest home are subject to a much lower probability for an autopsy with an OR of 0.03 compared to persons dying in a hospital. Moreover, all other locations (living address, transport, and other institutions/places of death) express a lower probability than the location hospital.

Persons dying between February and December have a lower probability of autopsy than in the reference month January. The largest difference demonstrates December with an OR of 0.91.

The weekday of death shows a quite small influence on the autopsy probability. The largest difference to the

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Table 1 Odds ratio (autopsy): religion, nationality, family status, institution/place of death, month of death, and weekday of death

Effect	Odds ratio	Lower 95 % CI	Upper 95 % CI
Religion			
Reference = Roman Catholic			
Protestant	1.01	0.99	1.03
Old catholic	1.14	1.06	1.21
Jews	0.28	0.24	0.31
Islamic	0.60	0.56	0.63
Other religion	0.94	0.90	0.99
Unknown	1.21	1.20	1.22
Nationality			
Reference = Austrian			
Foreigner	1.04	1.01	1.07
Family status			
Reference = married			
Single	1.32	1.30	1.34
Widowed	1.16	1.15	1.17
Divorced	1.42	1.40	1.44
Institution/place of death			
Reference = hospital			
Rest home	0.03	0.03	0.03
Living address	0.15	0.15	0.15
Transport	0.58	0.55	0.62
Others	0.22	0.22	0.23
Month of death			
Reference = January			
February	0.99	0.97	1.01
March	0.99	0.97	1.01
April	0.99	0.97	1.01
May	0.97	0.95	0.99
June	0.98	0.96	1.00
July	0.96	0.94	0.97
August	0.96	0.94	0.98
September	0.97	0.95	0.99
October	0.97	0.95	0.99
November	0.98	0.97	1.00
December	0.91	0.89	0.92
Weekday of death			
Reference = Sunday			
Monday	1.08	1.07	1.10
Tuesday	1.07	1.06	1.09
Wednesday	1.05	1.03	1.07
Thursday	1.03	1.01	1.05
Friday	0.97	0.96	0.99
Saturday	0.97	0.96	0.99

reference day Sunday is shown by Monday with an Odds ratio of 1.08. Friday and Saturday are the only weekdays that show a lower probability of post mortem examination (OR = 0.97).

The significant interaction year of death × sex may be demonstrated by the OR for autopsy and sex calculated for the years 1990 and 2009. The OR dropped from 1.16 in 1990 to 1.10 in 2009 showing that the difference in autopsy prevalence rates between men and women only declined slightly within the observation period.

The regression results show that there exist significant and relevant differences in the time trends between the provinces with Tyrol as the most extreme where the predicted probability drops from close to 60 % to about 30 %. In contrary Upper Austria remains at a value close to 60 % during the whole period.

Figure 1 compares the predicted probability of autopsy among different age groups by year of death for age groups 0 to 60 for a fictitious man belonging to the Roman Catholic religion died on a Monday in January in a hospital, single at time of death and of Austrian nationality (scale range from 0.4 to 1). This figure clearly presents the dramatic decrease in the autopsy prevalence rate for the very young age group of 0 to <1 years from about 93 to 62 %. Only autopsy prevalence rates in the age groups 10 to <20 and 20 to <30 years were nearly stable between 1990 and 2009. The regression model results (not shown) affirm that a decreased time trend is not only visible in the rest of the illustrated age groups but also in the age groups over 60 years.

A lot of publications have described the decline of autopsy prevalence rates in most developed countries in the latter half of the 20th century [2]. Our study confirms that this trend has continued. Moreover, we have demonstrated that in Austria the fall of autopsies is almost entirely a result of the decline in the number of clinico-pathological autopsies. Between 2004 and 2009 the frequency of clinico-pathological autopsies decreased from 18.2 to 14.2 % of all deaths. The medicolegal autopsy prevalence rate remained stable on a low level at about 1.5 %. Nevertheless, autopsy prevalence rates in Austria are high compared

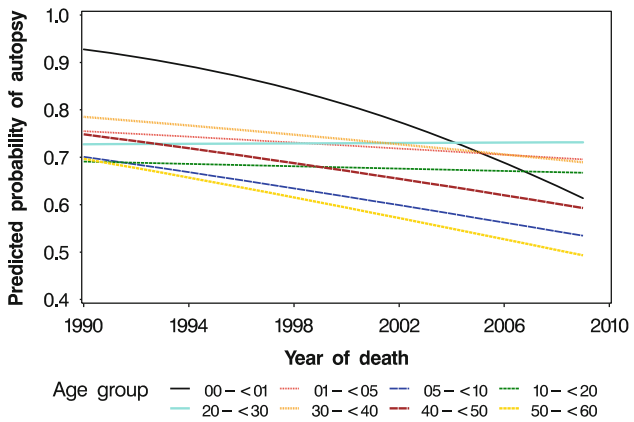

Fig. 1 Predicted probability of autopsy between 1990 and 2009 regarding age group

to other countries [2, 3], because the law permits autopsies to be carried out without the consent of the grieving family.

The difference in autopsy prevalence rates between men and women only declined slightly within the observation period. The probability to be autopsied is higher among singles, widowed and divorced people compared to married couples. Mostly the remaining spouse is able to give reliable information—such as underlying illnesses of the deceased, circumstances at the time of death—to the physician performing the post mortem external examination, so that an autopsy often is not necessary.

We note a sharp decline in the autopsy prevalence rate for the very young age group of 0 to <1 years. Advances in imaging, clinical laboratory studies, and surgical and nonsurgical tissue sampling techniques over the past decade have dramatically influenced the quality of antemortem evaluation, helping to define the location and extent of disease and yielding a greater number of antemortem diagnoses. Such aspects may have contributed to shifting pediatricians attitudes toward the autopsy, though it is not clear whether this attitude is matched by actual observed decay in the yield of valuable or new information obtained by postmortem examination.

One other reason for the decline in autopsy prevalence rates is that there has been a shift in care. Now, older and sicker patients are often dying in long-term facilities as well in hospice care settings. Our results show that persons dying in a rest home are subject to a much lower probability for an autopsy compared to persons dying in a hospital. Moreover, all other places of death exhibit a lower probability than hospitals. Autopsies are rarely performed upon nursing-home-residing patients who die either in the nursing home or at the acute hospital. Therefore, the elderly have the lowest rate of autopsies of any age group.

Some religious traditions place a strong emphasis on the inviolability of human remains and view anything much more than ritual cleaning of the body as a desecration. As shown in our study, Jews demonstrate the lowest autopsy prevalence rate. In contrast, the probability of autopsy is highest among persons with unknown religious affiliation.

Considering that family consent is not needed for autopsy these discrepancies are surprising. We conjecture that especially for deaths at home the grieving family may have a non-negligible influence on the decision made by the treating physician.

A minimum autopsy prevalence rate is no longer required for hospital accreditation, so there is no push to maintain a certain standard rate. Also the increasing costs are a factor for the decrease in the number of clinico-pathological autopsies. Similar e.g. to Canada, in Austria, these costs are covered by the hospital [4]. With exception of two Austrian provinces, in all other seven provinces autopsy prevalence rates are decreasing strongly during the observation period. Therefore, the main reason could be that most of the hospital administrators want to spend only a small portion of their budget on autopsies. On the other side, costs of medicolegal autopsies are covered under local and state governments as part of their annual operating budgets.

In some countries public objection to autopsy has led to a search for minimally invasive alternatives [5]. But new technologies, such as postmortem radiology and imaging instead of full autopsies that may relate to a decline in autopsies are not applied in Austria.

The strength of our study is our data set with more than 1.5 million individual observations each providing important variables influencing the individual probability for autopsy. In contrast to other studies found in the literature it enables estimation of interaction terms between variables which generally is not possible when using aggregated data. Furthermore, our data cover whole Austria between 1990 and 2009 thus providing population based data in contrast to hospital based data. We are not aware of any other population based study in the literature which relates autopsy status and influencing variables on an individual level.

The declining autopsy prevalence rate in Austria seems to be in line with the international trend. If this tendency continues, it will have a negative impact on the reliability of mortality statistics in general and, in the individual case, increase the possibility of incorrect classification of the cause of death. In the worst instance this might result in failure to detect homicide.

Nonetheless, reliable information on causes of death is essential to inform health policy and allocate the scarce health resources in resource-limited settings. Therefore, the future of autopsy lies in promoting public support for autopsies. Also alternative methods, such as minimal invasive autopsies, may provide an opportunity to increase the number of pathology proven diagnoses.

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Conflict of interest The authors declare that they have no conflict of interest.

Ethical standards For this study only retrospective data records from Statistics Austria but no experimental data were used.

References

1. Statistics Austria. Mortality records 1990–2009. Vienna: Statistics Austria; 2010.

2. Madea B, Rothschild M. The Post mortem external examination: determination of the cause and manner of death. Dtsch Arztebl Int. 2010;107(33):575–86.
3. Oluwasola OA, et al. The autopsy: knowledge, attitude and perceptions of doctors and relatives of the deceased. Arch Pathol Lab Med. 2009;133(1):78–82.
4. Lowry F. Failure to perform autopsies means some MDs "walking in a fog of misplaced optimism". CMAJ. 1995;153:811–4.
5. Roberts IS, Benamore RE, Benbow EW, et al. Post-mortem imaging as an alternative to autopsy in the diagnosis of adult deaths: a validation study. Lancet. 2012;379(9811):136–42.