The quality of medical autopsy reports

ORIGINAL ARTICLE

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BACKGROUND
Medical autopsies are rarely made subject to quality assurance. We have investigated the quality of autopsy reports in Norway and assesses

MATERIAL AND METHOD
Every fifth medical autopsy report for adults (> 2 years) in 2014 was reviewed. The significance of the autopsy result for the registration of the cause of death was issued by the clinician with the coding in the Cause of Death Registry after the autopsy.

RESULTS
A total of 389 autopsy reports from 15 departments of pathology were reviewed. The autopsy request, as well as the death certificate and the neuropathological examination were available for 393 and 360 cases respectively. Ninety-five requests had specified clinical questions, but were commented on by finding, even in cases of pathological deviations from a normal weight. A post-mortem virus examination or toxicology had been performed time for autopsies without and with a neuropathological examination was 99 and 138 days respectively. Errors in reporting the cause of death were most frequently for deaths from cardiovascular diseases. The autopsy result led to a change to the cause of death in the Cause of Death Registry. Errors in the formulation of the autopsy result resulted in erroneous coding of the cause of death in 22 out of 47 (47%) of cases.

INTERPRETATION
...
The proportion of autopsy reports with errors in the formulation of the cause of death was unexpectedly high and may have consequences for the quality of medical autopsy reports. The main findings include:

**Main Findings**

The quality of medical autopsies is characterised by long turnaround times and errors in the formulation of the cause of death. The median turnaround time for autopsies with no supplementary examinations or brain examination was 99 days, and 138 days if such examinations were performed. Up to one in every five autopsy reports contained errors in the formulation or failed to state the cause of death, with subsequent erroneous classification in 47% of the cases.

The declining frequency of autopsies is an internationally known trend. In the 1980s, approximately 6,000 medical autopsies were performed in Norway each year. In 2018, this figure had fallen to 1,397, or 3% of all deaths. In a survey on autopsy practices in Europe in 2017, better than 60% of autopsies were reported as possible causes of the declining number of autopsies. One might well ask whether the quality of the autopsies is affected, and only available in the clinical records of each institution. The autopsy activity was highest in the university hospitals and lowest in other hospitals. The number of reports accounted for 23% of all adult medical autopsies in 2014.

A total of 389 medical autopsy reports were obtained from 15 departments of pathology. The project group assessed errors in the formulation of findings, in terms of both the ICD/WHO regulations and the content of the reports. The project group consisted of three pathologists with expertise in gross and microscopic examinations, microscopy and additional investigations such as toxicology, virology, microbiology and genetic analysis. Where possible, the body was examined after the autopsy, and recorded whether these contained sufficient clinical information to understand the cause of death. The front page of the autopsy report is forwarded to the Cause of Death Registry, which collates the findings with the original death certificate to determine the cause of death.

Autopsy is often highlighted as the gold standard for morphological diagnostics and determining the cause of death, despite the fact that the results are thus an important component of the source data for the cause of death statistics. As a member of the World Health Organization (WHO), Norway is obligated to maintain official cause of death statistics, using the International Classification of Diseases and Related Health Problems (ICD-10). Findings made in an autopsy shall be registered in the same way as in the completion of the death certificate. A distinction is requested by the public prosecutor as part of a criminal investigation, and medical autopsies are requested by a doctor as part of a quality assurance programme. Medical autopsies in Norway are performed by medical specialists or trainees in pathology. The reporting format for medical autopsies is standardized across the country.

**Box 1 Format for the medical autopsy report**

**Clinical history and issues**

From the autopsy request and/or the clinical records.

**External examination**

Sex, weight, height, distinguishing features, scars, signs of disease, injuries etc.

**Internal examination**

Gross description of cavities, arteries, internal organs (including their shape and weight). Microscopic examination of tissue from the heart, lungs, liver and kidneys (standard), as well as from other organs with suspected pathology. Supplementary examinations as required: bacteriology, virology, toxicology, genetics.

**Formulation of findings, as a rule on the front page**

1a–d: The cause of death as chain of events, from the immediate to the underlying. 2: Contributory disease/diseases. 3: Secondary findings: Diseases or findings with no bearing on the process of death. Assessment: A discussion of the findings, addressed to the clinician.

The study was approved by the Data Protection Officer at Akershus University Hospital (16–106) and the Regional Committee for Medical and Health Research Ethics (2017/1726-2/5/8/603). Results

A total of 389 medical autopsy reports were obtained from 15 departments of pathology. The number of reports accounted for 23% of all adult medical autopsies in 2014. Autopsy requests were available for 339 autopsy reports (86.7%). Autopsy requests were available for 339 autopsy reports (86.7%). Autopsy requests were available for 339 autopsy reports (86.7%).
Table 1

Autopsy reports for deceased persons older than two years in 2014, by type of hospital, sex and age (n = 389).

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>University hospitals, n = 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of reports (range)</td>
<td>389</td>
<td></td>
</tr>
<tr>
<td>Number of men (%)</td>
<td>241 (62)</td>
<td></td>
</tr>
<tr>
<td>Median age (range) Men</td>
<td>70 (21–93)</td>
<td></td>
</tr>
<tr>
<td>Median age (range) Women</td>
<td>75 (16–98)</td>
<td></td>
</tr>
</tbody>
</table>

REQUEST, CLINICAL ISSUES AND MEDICAL HISTORY

Clinical issues stated by the clinician were present in 95 of 339 autopsy requests, often formulated as a wish to confirm/disprove pulmonary disease. These 95 autopsy reports attempted to answer the issue. In the remaining 244 requests, the wish for an autopsy was formulated as ‘Cause of death’. The results from pre-mortem laboratory examinations and on medication use were provided in 225 and 153 cases respectively.

EXTERNAL AND INTERNAL EXAMINATION

Comments on external findings and signs of death were provided in 284 and 311 reports respectively. Body mass index was calculated in 41 of the autopsies. Overweight was defined as a BMI ≥ 30, and obesity as a BMI > 40. Overweight was stated in 7 out of 85 cases and in 3 out of 10 with a BMI > 40. Overweight was stated as a diagnosis in 5 out of 360 cases, and never as an underlying cause of death.

Most organs and organ systems were adequately described, with the exception of specification of lung and kidney weight by left and right location within the organs of pathological findings. The location of pathological findings in the heart and lungs was stated in 96 and 79 cases respectively. The brain was examined in 338 autopsies. The examinations were conducted on non-fixated brains without microscopy in more than one case.

SUPPLEMENTARY EXAMINATIONS

The use of supplementary examinations varied in the autopsies, also in cases of non-hospital deaths where the clinical information was often incomplete. In 88 and 28 reports respectively, while one case had been examined for viruses (influenza). There were no cases of MORS SUBITA

Mors subita, ‘sudden death’ or similar was stated as the cause of death in 13 autopsy reports. The project group assessed five of these as inconclusive possible explanations.

ASSESSMENT

A more detailed explanation of the formulation of the findings or comments on clinical issues were found in 329 out of 389 reports. In 91 cases, the cause of death was already presented in the formulation.

TURNAROUND TIME

Average turnaround times without and with a neuropathological examination amounted to 99 and 138 days respectively. The longest turnaround times with neuropathology. There were no significant differences in turnaround times in university hospitals and other hospitals.

UNDERLYING CAUSE OF DEATH

The formulation of findings with the cause of death in accordance with the World Health Organization was deemed correct most frequently in malignant disease (Table 2). Every fifth death from cardiovascular causes was deemed to have been incorrectly formulated. In total, an erroneous or not formulated cause of death was mentioned in 30 cases (error categories 5–6), in 55 cases, it was not stratified in accordance with the Regulations on the Cause of Death Registry and could therefore not be coded. There were no differences between university hospitals and other hospitals.

Table 2

Underlying cause of death in autopsy reports for deceased persons older than two years from 2014 (n = 389), assessed on the basis of the WHO content.

<table>
<thead>
<tr>
<th>Type of disease</th>
<th>Total number</th>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant disease</td>
<td>95</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular disease¹</td>
<td>140</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>Pulmonary disease²</td>
<td>16</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Infection³</td>
<td>52</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Other disease⁴</td>
<td>68</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Unnatural causes⁵</td>
<td>18</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>389</td>
<td>320</td>
<td></td>
</tr>
</tbody>
</table>

¹Including pulmonary embolism and aneurysm.
²Including pulmonary emphysema/COPD and pulmonary fibrosis.
³Including endocarditis, diverticulitis and pancreatitis.
⁴Including alcohol, diabetes, ulcer, amyloidosis, dementia and multiple sclerosis.
⁵Including accidents, avalanches, falls, hangings and poisonings.

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CONCLUSION

Our study corroborates the continued need for systematic quality control of medical autopsy work.

Forensic autopsy reports undergo quality assurance by the Norwegian Board of Forensic Medicine, which may cause competence levels to drop even further. However, that pathologists need better knowledge about reporting of findings and causes of death. A generally low number of medical autopsies were performed within a few days, provided that the clinician has completed the request for an autopsy. The autopsy procedure takes no more time than for other kinds of tissue diagnostics; the specimens can be examined and the report completed without the need for autopsies to be a separate discipline. Non-inclusion of clinical findings and infrequent use of supplementary examinations during autopsy may testify to a lack of focus on the importance of autopsies in pathology departments, where diagnostics of samples from patients with communicable diseases are underreported. There are no available guidelines for the use of supplementary examinations in medical autopsies. Toxicological examinations could be of great importance to the reporting of findings and causes of death, and may also reflect a capacity problem, not least with regard to neuropathology.

IMPACT ON THE CAUSE OF DEATH STATISTICS

A copy of the original death certificate and the associated code string from the Cause of Death Registry was available for 360 out of 389 deceased patients. Final coding of the death in the Cause of Death Registry showed that the autopsy had caused a change in 206 cases (57%). In 140 cases, the death in ICD-10, for example from infection to cardiovascular disease, while 66 deaths were assigned to a different sub-chapter. The WHO regulations ensured a correct coding of the autopsy results in many cases with errors in the formulation of the underlying cause of death as a contributory cause or as a secondary finding resulted in a larger proportion of erroneous coding (category 2 errors). Four out of five autopsies were coded correctly because the Cause of Death Registry collected supplementary information. In total, nearly one-half of all the autopsy reports contained errors in erroneous coding in public statistics.

DISCUSSION

Autopsy is a medical procedure which is often held up as the gold standard for determining the cause of death. However, astonishingly little research has been made. A North American study examined only the information on the front page of the reports, and concluded that forensic autopsies from the UK concluded that the quality was poor or unacceptable in 25% of these (15).

It is important to specify that our study does not concern the quality of how the autopsy itself is performed, it refers only to the reporting. The reports contained adequate descriptions of the findings, but had greater deficiencies when it came to addressing the clinician’s questions. A direct answer to a specific question from the requisitioner was provided in only one-third of the cases. The reason for this lack of communication was that the clinicians were regarded as standard phrases, but could also be due to the long turnaround times, with little focus on the requisitioner’s question. The need for autopsy to be a separate discipline has also been proposed in the Netherlands, Germany and the UK.

The importance of autopsies has changed. From an original focus on pathological (anatomical) findings, the importance of assessing findings has been emphasised (19). In the absence of any knowledge of the patient's medical history and without including the clinical picture, many types of errors are made, and the specimes are not always correctly examined and the report com is not necessarily taken longer than for other kinds of tissue diagnostics; the specimens can be examined and the report completed without the need for autopsies to be a separate discipline. Non-inclusion of clinical findings and infrequent use of supplementary examinations during autopsy may testify to a lack of focus on the importance of autopsies in pathology departments, where diagnostics of samples from patients with communicable diseases are underreported.

The autopsy reports in our study date from 2014, but no changes have been made to medical autopsy practices in Norway before or after this time. In our example, the clinician was asked to provide all relevant information, which was included in the report. The autopsy procedure takes no more time than for other kinds of tissue diagnostics; the specimens can be examined and the report completed without the need for autopsies to be a separate discipline. Non-inclusion of clinical findings and infrequent use of supplementary examinations during autopsy may testify to a lack of focus on the importance of autopsies in pathology departments, where diagnostics of samples from patients with communicable diseases are underreported.

Close to every fifth autopsy report stated a wrong underlying cause of death. The algorithms in the WHO regulations that the Cause of Death Registry collected supplementary information. In total, nearly one-half of all the autopsy reports contained errors in erroneous coding in public statistics.

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Table 3

<table>
<thead>
<tr>
<th>Type of error</th>
<th>Example</th>
<th>Error in the formulation of the cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error in the chain of events of the underlying cause of death</td>
<td>Ia: Acute myocardial infarction</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
<tr>
<td>The underlying cause of death was placed under II or secondary findings</td>
<td>Ib: Coronary atherosclerosis</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
<tr>
<td>Multiple independent diseases listed as the underlying cause of death</td>
<td>Ic: COPD</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
<tr>
<td>The underlying cause of death is listed as both an underlying and contributory disease.</td>
<td>Pneumonia</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
<tr>
<td>Mors subita, no linkage to the assumed underlying cause of death</td>
<td>Heart with infarction, aortic stenosis and amyloidosis</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
<tr>
<td>Total</td>
<td>Pronounced coronary atherosclerosis</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
<tr>
<td>Total</td>
<td>Heart with old infarction</td>
<td>Error in the chain of events of the underlying cause of death</td>
</tr>
</tbody>
</table>

1 Code string not received for one case
2 Code string not received for two cases

The WHO regulations ensured a correct coding of the autopsy results in many cases with errors in the formulation of the underlying cause of death as a contributory cause or as a secondary finding resulted in a larger proportion of erroneous coding (category 2 errors). Four out of five autopsies were coded correctly because the Cause of Death Registry collected supplementary information. In total, nearly one-half of all the autopsy reports contained errors in erroneous coding in public statistics.

Example

1 a: Acute myocardial infarction
1 b: Coronary atherosclerosis
1 c: COPD

2 a: Pneumonia
II or secondary findings: Advanced multiple sclerosis

III: Heart with infarction, aortic stenosis and amyloidosis

Mors subita, no linkage to the assumed underlying cause of death

Pronounced coronary atherosclerosis

Heart with old infarction

Peritonitis

Mors subita

Pronounced atherosclerosis

Summary

The quality of medical autopsy reports is a well-known problem internationally as well. In our example, the clinician was asked to provide all relevant information, which was included in the report. The autopsy procedure takes no more time than for other kinds of tissue diagnostics; the specimens can be examined and the report completed without the need for autopsies to be a separate discipline. Non-inclusion of clinical findings and infrequent use of supplementary examinations during autopsy may testify to a lack of focus on the importance of autopsies in pathology departments, where diagnostics of samples from patients with communicable diseases are underreported.
There is a need to increase the focus on the quality of medical autopsy reports. Ensuring that pathologists are knowledgeable about the forensic aspects and improving their communication with clinicians, including measures to reduce the turnaround times, would be good contr

**LITERATURE**

19. 27. Erlemeier F, Weichert W, Krichel R et al. Erwachsenenobduktionen im letzten Jahrhundert in Deutschland: Daten zweiter Universitätskliniken. Pathol