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The quality of medical autopsy reports

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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 assessed the impact of errors on the cause of death statistics.

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 cause of death was studied by comparing the death certificate 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 codes for the cause of death from the Cause of Death Registry were available for 339 and 360 cases respectively. Ninety-five requests had specified clinical questions, but were commented on by the pathologist in 33 cases. Obesity was rarely reported as a finding, even in cases of pathological deviations from a normal weight. A post-mortem virus examination or toxicology had been performed in 1 and 28 autopsies respectively. The average turnaround time for autopsies without and with a neuropathological examination was 99 and 138 days respectively. Errors in reporting the cause of death or inadequate reporting were evident in 69 cases (18 %), 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 in 206 out of 360 (57 %) cases for which coding data were available. 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 with errors.

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 cause of death statistics. Long turnaround times for autopsies complicate communication with the clinician about the findings.

The declining frequency of autopsies is an internationally known trend (1). In the 1980 s, approximately 6 000 medical autopsies were performed in Norway annually, corresponding to nearly 15 % of all deaths (2). In 2018, this figure had fallen to 1 397, or 3 % of all deaths (3, 4). In a survey on autopsy practices in Europe in 2017, better diagnostic methods and dearth of interest from pathologists and clinicians were reported as possible causes of the declining number of autopsies (5). One might well ask whether the quality of the autopsies could also be a factor behind their declining frequency.

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 (ICD) (6, 7). The cause of death is reported by the clinician in the Medical Certificate of Death (death certificate) and is registered as the underlying cause of death (Section 1 a–d on the death certificate) as well as other contributory causes of death (Section 2). Pursuant to the regulations on collection and processing of health information in the Cause of Death

Registry (Regulations regarding the Cause of Death Registry), findings made in an autopsy shall be registered in the same way as in the completion of the death certificate (8). A distinction is made between two types of autopsies: forensic autopsies are 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 procedure for medical work and teaching. Medical autopsies in Norway are performed by medical specialists or trainees in pathology. The reporting format for medical autopsies in Norway has remained unchanged for decades, and follows the same pattern nationwide (see Box 1).

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

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

The front page of the autopsy report is forwarded to the Cause of Death Registry, which collates the findings with the original death certificate and corrects the cause of death if required. The autopsy result is thus an important component of the source data for the cause of death statistics (9, 10).

Autopsy is often highlighted as the gold standard for morphological diagnostics and determining the cause of death, despite the fact that no systematic quality control is undertaken for this aspect of medical work (11). We therefore wished to examine the quality of Norwegian autopsy reports with regard to their content, formulation of findings and turnaround times. Moreover, we wished to investigate how errors in the formulation of causes of death impacted on the cause of death statistics.

Material and method

Every fifth autopsy report for deceased persons older than two years (adult autopsy) in the period 1 January–31 December 2014 was requested from Norwegian pathology departments. Before de-identification, the deceased person's sex and age were registered, as well as the type of hospital where the autopsy had been performed (university hospitals and others) and the turnaround time, defined as the time between the autopsy date and the signing of the final report. A project group consisting of three pathologists with experience from autopsy pathology (HME, RBB, AJS) rotated the autopsy reports between them in two rounds, and recorded whether these contained sufficient clinical information to understand the course of disease, data from the external and internal examinations, microscopy and additional investigations such as toxicology, microbiology and genetic analysis. Where possible, the body mass index (BMI) was calculated (12). In their evaluation

of the autopsy reports, the group had no access to clinical information other than what was referred to in the autopsy reports and/or the autopsy requests.

The project group assessed errors in the formulation of findings, in terms of both the ICD/WHO regulations and the content of the reports, and categorised these as 1) errors in the chain of events of underlying cause of death in Section 1 a–d; 2) misplacement of the underlying cause of death as contributory disease in Section 2 or as a secondary finding; 3) listing of multiple independent diseases as the underlying cause of death; 4) listing of the underlying cause of death in more than one section, for example as both underlying and contributory disease; 5) underlying cause of death not stated; 6) mors subita, 'sudden death' or similar expression not linked to a specific disease; and 7) generally incomplete reports with no reliable cause of death stated. The group also recorded whether the findings were discussed in an assessment.

All cases with disagreement regarding the categorisation of errors were discussed by the group as a whole to reach a consensus. A copy of the death certificate and the final coding of the cause of death (code string) after any corrections had been made on the basis of the autopsy result were requested from the Cause of Death Registry and compared to the content and formulation of the cause of death in the autopsy reports.

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 (REK) (2016/619). Permission to process health information was obtained from the Norwegian Data Protection Authority (16/01121 - 2/ SBO).

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 (13). Autopsy requests were available for 339 autopsy reports. In the remaining 50 autopsy reports, the autopsy request was not attached, and only available in the clinical records of each institution. The autopsy activity was highest in the university hospitals (Table 1). The majority of the autopsies had been performed on men (62 %). The median age was 75 years for women and 70 years for men. Altogether 59 (15 %) of the autopsies had been performed on persons who had died outside hospital. The proportion of autopsies for non-hospital deaths was higher in hospitals other than the university hospitals (23 % and 12 % respectively).

Table 1

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

	Total	University hospitals, n = 6	Other hospitals, n = 9
Number of reports (range)	389	270 (17–71)	119 (4–21)
Number of men (%)	241 (62)	171 (63)	70 (59)
Median age (range)			
Men	70 (21–93)	71 (21–93)	68 (25–93)
Women	75 (16–98)	74 (16–98)	75 (42–93)

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 embolism, myocardial infarction or haemorrhage. Of these, 33 autopsy reports attempted to answer the issue. In the remaining 244 requests, the wish for an autopsy was formulated as 'Cause of death?' or similar. Six

autopsy reports contained no medical history. 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 reports. Underweight (BMI < 18.5) was never included in the formulation of diagnoses. Obesity (BMI ≥ 30) was stated as a diagnosis in 7 out of 85 cases and in 3 out of 10 with a BMI > 40. Overweight was also rarely stated as a diagnosis on the death certificate or in code strings from the Cause of Death Registry (5 and 9 out of 360 respectively), 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 side, which was given in 103 and 183 reports respectively, and 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-half of the cases (190 out of 338). No microscopy was performed on 26 out of 148 fixated brains.

SUPPLEMENTARY EXAMINATIONS

The use of supplementary examinations varied in the autopsies, also in cases of non-hospital deaths where the clinical information was often sparse. A post-mortem bacteriological or toxicological examination was stated in 88 and 28 reports respectively, while one case had been examined for viruses (influenza). There were no cases of genetic analysis.

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 incorrect, with no linkage to disease or discussion of other 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 of these, the text gave no additional information beyond what 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 time without neuropathology was 203 days, and 345 days 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 autopsies concerning malignant disease or pulmonary disease (Table 2). Every fifth death from cardiovascular causes was deemed to have been incorrectly formulated. In total, an erroneous or no cause of death was found in one in every five reports (69 out of 389).

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 World Health Organization's regulations for formulation and content.

		Formulation of the underlying cause of death		
Type of disease	**Total number**	**Correct**	**Incorrect**	**Inadequate reports**
Malignant disease	95	92	3	0
Cardiovascular disease[1]	140	105	30	5
Pulmonary disease[2]	16	13	3	0
Infection[3]	52	40	9	3
Other disease[4]	68	57	9	2
Unnatural causes[5]	18	13	3	2
Total	389	320	57	12

[1]Including pulmonary embolism and aneurysm.

[2]Including pulmonary emphysema/COPD and pulmonary fibrosis.

[3]Including endocarditis, diverticulitis and pancreatitis.

[4]Including alcohol, diabetes, ulcer, amyloidosis, dementia and multiple sclerosis

[5]Including accidents, avalanches, falls, hangings and poisonings.

The types of errors are specified in Table 3. The cause of death was mentioned, but at the wrong place in the formulation, in 30 cases (error categories 1–4). The other reports that were deemed erroneous (error categories 5–6) were either without a stated or definite cause of death. There were no differences between university hospitals and other hospitals in terms of their types of error categories. Six cases were not stratified in accordance with the Regulations on the Cause of Death Registry and could therefore not be categorised. Twelve autopsy reports were deemed inadequate, with such major deficiencies in their content that they were not assessed with a view to their formulation and coding.

Table 3

Number of autopsy reports that were considered to have incorrectly formulated the underlying cause of death and the number with resulting erroneous coding in the Cause of Death Registry, based on a sample of autopsy reports from 2014 (n = 371). Six reports that did not comply with the World Health Organization's regulations and twelve inadequate reports were excluded.

Type of error	**Example**	**Error in the formulation of the autopsy report**	**Subsequent coding error for the cause of death**
Error in the chain of events of the underlying cause of death, 1 a–c.	1 a: Acute myocardial infarction 1 b: Coronary atherosclerosis 1 c: COPD	8	3
The underlying cause of death was placed under II or under secondary findings.	Ia: Pneumonia II or secondary findings: Advanced multiple sclerosis	10[1]	6
Multiple independent diseases listed as the underlying cause of death.	Ia: Heart with infarction, aortic stenosis and amyloidosis	12	3

Type of error	Example	Error in the formulation of the autopsy report	Subsequent coding error for the cause of death
The underlying cause of death is listed as both an underlying and contributory disease.	Ia: Heart with recent infarction Ib: Pronounced coronary atherosclerosis II: Heart with old infarction	–[2]	–
The underlying cause of death is not stated.	Ia: Peritonitis	13	9
Mors subita, no linkage to the assumed underlying cause of death	Ia: Mors subita II or secondary findings: pronounced atherosclerosis	4[1]	1
Total		47	22

[1]Code string not received for one case

[2]Code string not received for two cases

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 deaths. Comparisons of the original death certificate and the 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 autopsy result led to a change of main chapter of cause of 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 (Table 3). Misplacement 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 13 cases reported with no cause of death or as 'mors subita' were coded correctly because the Cause of Death Registry collected supplementary information. In total, nearly one-half of all the autopsy reports with errors in formulating the cause of death resulted 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 attention is devoted to quality assurance of the method itself, and few studies have been made. A North American study examined only the information on the front page of the reports, and concluded that standardisation was needed (14). A more detailed study of 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. Our review of medical autopsies shows that the majority of the reports contained adequate descriptions of the findings, but had greater deficiencies when it came to addressing the clinician's questions, causes of death and turnaround times.

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 comments on specific questions could be that the issues listed by the clinicians were regarded as standard phrases, but could also be due to the long turnaround times, with little focus on the requisitioner when the report is finally written. Most autopsies are performed within a few days, provided that the clinician has completed the request for an autopsy. The autopsy procedure takes no more than a couple

of hours. The production of samples for microscopy will not necessarily take longer than for other kinds of tissue diagnostics; the specimens can be examined and the report completed within a week. The long time spans from the performance of the autopsy until the report is distributed is a well known problem internationally as well (15, 16). Our study revealed turnaround times that are well above what is recommended in the guidelines from the Norwegian Society of Pathology (DNP), which indicate turnaround times of two and eight weeks for autopsies without and with neuropathology respectively (17). Long turnaround times may testify to a lack of focus on the importance of autopsies in pathology departments, where diagnostics of samples from the living are prioritised above those from the deceased, and may also reflect a capacity problem, not least with regard to neuropathology. In a study undertaken at the University Hospital in Bergen, reorganisation of the pathology department helped reduce the turnaround times significantly (18).

The importance of autopsies has changed. From an original focus on pathological/anatomical findings, the importance of assessing findings in connection with the clinical aspects has come to be emphasised (19). In the absence of any knowledge of the patient's medical history and without including the clinical picture, many types of causes of death may be overruled in the autopsy reports, and thereby also in the cause of death statistics. Non-inclusion of clinical findings and infrequent use of supplementary examinations during autopsies may be reasons why issues such as psychiatric conditions or diabetes are frequently underreported by pathologists as underlying causes of illness and death (20). Our study also shows that little importance is placed on a significant gross finding such as obesity, despite the fact that this is a potentially lethal condition. The consequences for monitoring of public health and the obesity epidemic are obvious (21). Interdisciplinary post-mortem meetings would help ensure that relevant information is considered in the reports and contribute to better communication with the clinician.

There are no available guidelines for the use of supplementary examinations in medical autopsies. Toxicological examinations could be of particular value in cases of death with little or no clinical information. The small proportion of toxicological examinations could be due to the high costs involved (22). Lack of supplementary examinations for viruses indicates that virus-induced 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 period. There is thus no reason to believe that the autopsy reports from 2014 fail to reflect current autopsy practice. The comparison of autopsy findings in our study with the cause of death statistics confirmed that autopsy is an important corrective to the determination of cause of death, as the coding was changed in one-half of the cases. This has also been pointed out by others (22, 23). Because difficult cases are selected when the autopsy frequency is low, the proportion of 57 % change in the cause of death coding is likely to be unnaturally high.

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 is using capture the most obvious errors in the formulation of the cause of death, and not all types of errors are therefore equally critical to the statistics (24). For instance, in our example of category 1 errors in Table 3, the algorithms would have prevented a miscoding by recognising an illogical chain from 1 c to 1 b (COPD does not cause coronary atherosclerosis). The errors nevertheless resulted in a miscoding in the statistics for nearly one-half of the faulty reports. The low autopsy frequency means that poor quality of the autopsy reports currently has little impact on the national cause of death statistics. The error rate confirms, however, that pathologists need better knowledge about reporting of findings and causes of death. A generally low number of medical autopsies has led to reduced requirements for specialist training, which may cause competence levels to drop even further (5). Medical autopsies are performed by trainees and specialists in pathology. To improve the quality, the UK has made medical autopsy a sub-specialty (25). The need for autopsy to be a separate discipline has also been proposed in the Netherlands, Germany and the United States (26–28).

Forensic autopsy reports undergo quality assurance by the Norwegian Board of Forensic Medicine (29). A similar body for medical autopsies has previously been proposed, but not established (30). Our study corroborates the continued need for systematic quality control of medical autopsy work.

CONCLUSION

There is a need to increase the focus on the quality of medical autopsy reports. Ensuring that pathologists are knowledgeable about the formulation of findings and causes of death after medical autopsies and improving their communication with clinicians, including measures to reduce the turnaround times, would be good contributions to this end.

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 included.

Up to one in every five autopsy reports contained errors in the formulation or failed to state the cause of death, with subsequent erroneous coding of the cause of death in the Cause of Death Registry in 47 % of the cases.

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