

Research Paper

The incidence of iatrogenic deaths in the Finnish cause-of-death statistics; a retrospective study

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ABSTRACT

Purpose: An adverse event in health care leading to death is a significant event when assessing patient safety. This study was designed in order to assess, how many iatrogenic deaths are registered in Finland annually, and what type of treatment they are mostly related to.

Methods: Material was collected using cause of death-statistics that includes “manner of death”-classification in Finland in 2014–2015.

Results: There were 350 cases that met the criteria of the study. In a majority of the cases (264, 75%), a medico-legal autopsy was performed. This represents only 1.4% of all medicolegal autopsies during the study period in Finland. The cases were most often related to medication (30%) or known high-risk procedures such as gastrointestinal surgery (23%) and cardiothoracic surgery (11%). Only 12% of the cases had no prior significant medical history. Patient characteristics were somewhat different among the surgical disciplines, probably reflecting treatment practices.

Conclusion: Deaths that are classified as iatrogenic are mostly related to known high-risk surgery or medication. Further studies are needed to assess the true incidence of malpractice among this material.

1. Introduction

Patient safety and health care quality are measured and analyzed using estimated numbers of avoidable mortality, presuming that the health care system is efficient and qualified. Avoidable mortality is further divided into preventable and amenable (treatable). Different diseases and conditions are included in these estimates. An OECD report includes “Misadventures to patients during surgical and medical care” as one factor of amenable mortality.¹

The definition of a misadventure/adverse event in health care varies in the literature. In some reports,^{1,2} mortality related to misadventures in health care is determined as including ICD-10 codes Y60–Y69 (misadventures to patients during surgical and medical care) and Y83–Y84 (surgical and other medical procedures as the cause of abnormal reaction of the patient, or of later complication, without mention of misadventure at the time of the procedure).

The estimates on the incidence of different types of misadventures in health care vary immensely. If a broad definition is used, and, for example, all infections related to hospital admissions are included, some estimates suggest that these adverse events occur in one of every three

hospital admissions, and could be tenfold compared to previous reports.³

In Finland, it has been discussed in national forums that there is not enough information regarding patient safety in health care.⁴ The National Institute for Health and Welfare coordinates the HILMO-system where all hospital admissions are recorded. This system includes information on misadventures related to these admissions, if they are reported accurately. The Patient Insurance Center records every incident that has been announced, and pays compensation in all cases of malpractice and in some cases of infections or other surgical complications. A hospital-based system for reporting all kinds of misadventures and errors, including near miss events, has been used in different institutions (HAIPRO), and this data is now to be harmonized. Depending on how misadventures are determined, their total number varies. Based on international reports, it is approximated that there would be 700–1,700 deaths related to misadventures in health care in Finland annually.^{5,6}

An adverse event in health care leading to death is a significant event when assessing patient safety. If an adverse event in health care is suspected to have contributed to the fatal outcome, the Finnish law states

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that a police investigation and a medico-legal cause of death -investigation should be undertaken, if the suspected cause of death is accident, suicide, homicide, treatment-related, occupational, or otherwise unexpected. Most often it is carried out including a medico-legal autopsy. (The Act on the Inquest into the Cause of Death 459/1973). In the Finnish system, there is no coroner or judge who decides on whether a medico-legal autopsy is to be undertaken. A forensic specialist determines the cause of death, and if adverse event is the cause of death with a possibility of malpractice, the National Supervisory Authority of Welfare and Health continues to investigate the accuracy of the medical treatment given, following a similar type of process as described in the European guideline report.⁷

In Finland, all death certificates from clinicians go to The National institute for Health and Welfare to be assessed by a forensic specialist. If the cause of death seems to be related to medical treatment, it should be reported to the police and the reporting date recorded to the death certificate. If not done so, the death certificate is returned to the clinician with appropriate instructions.

Cause of death statistics in Finland include "manner of death" classification that is not included in the WHO international classification. In this "manner of death"- classification, iatrogenic, consisting of medical treatment or investigative procedures is recorded separately. In Finland, deaths related to adverse events in health care have been studied earlier using cause of death statistics.⁸ In this study, it was found that an ICD-code indicating adverse event as the cause of death, and "manner of death" determined as iatrogenic was recorded in a very small number of cases. It was also noted that the definition of what is an adverse event related to health care is not at all unambiguous.

It has not been studied previously, what kind of cases are included in these deaths that are classified as iatrogenic in Finland.

Aims of the study

- 1) To determine how many deaths due to adverse events in health care were registered in cause of death statistics in Finland during 01 January 2015–31 December 2015 using "manner of death"-classification.
- 2) To analyze what types of complications there were and what kind of treatment they were most often related to, what was the mode of the cause-of-death investigation.

2. Materials and methods

Permission to gather data from autopsy reports and police reports was obtained from the National Institute for Health and Welfare (Document record no: THL/1078/6.02.00/2017). Permission to gather data from death certificates was obtained from Statistics Finland (Document record no: TK-53-1077-17).

2.1. Data collection

Data was gathered from death certificates obtained from Statistics Finland as well as from the autopsy reports of all medico-legal autopsies carried out in the National Institute for Health and Welfare during 2014–2015 (total n = 104,711).

Based on the data from death certificates, all cases in which the "manner of death" was recorded as iatrogenic were selected for the study (n = 359). Eight cases with obvious misclassification of the manner of death and one case in which the death had occurred abroad were also excluded, resulting in a total number of 350 cases. There were 9 primarily unreported cases in this material, in which the death certificate was returned to the clinician with instructions to report the death to the police. In addition, there were 6 cases in which the police investigation was primarily not seen necessary, and the iatrogenic cause was later found in the clinical autopsy. These reclassified cases comprise 4% of this material.

The sex, age, medical history, causes of death, manner of death and

the mode of death investigation (medico-legal autopsy, clinical autopsy, no autopsy) were analyzed. Medical history was classified as follows: 0) no clear indication or other immediate life-threatening condition leading to the described procedure or treatment as the cause of death, and also no other chronic, serious condition possibly to affect the outcome; 1) immediate indication or life-threatening medical condition directly related to the cause of death (e.g. cancer, acute coronary syndrome, heart failure) or other, chronic serious medical condition probably affecting the outcome; 2) several conditions mentioned in 1).

The causes of death were gathered according to the recorded ICD-10 codes, and also further classified according to the type of medical treatment or surgical procedure given as follows: 1) medication-related adverse event; 2) gastrointestinal surgery, including ERCP, PEG, and liver biopsies, excluding routine gastro- or colonoscopy; 3) arterial surgery and large vein catheters, including procedures to the carotid arteries, excluding intracranial procedures as well as heart and thoracic surgery; 4) orthopedic surgery; 5) urological surgery; 6) cardiothoracic surgery, including lung biopsies and surgical procedures on airways; 7) standard, smaller procedures, including, for example, routine gastro- or colonoscopy and thoracocentesis and/or pleural fluid drainage; 8) gynecological surgery; 9) neurosurgery and intracranial artery operations; 10) cardiological operation such as angiography, transcatheter procedures and pacemaker-related events, excluding surgical operation included in group 6; 11) other medical or surgical treatment, including radiation therapy, hemodialysis and rejection reactions.

Group 7, standard small procedures, included 10/22 thoracocentesis and/or pleural fluid drainage complications, 8/22 gastro/colonoscopy related complications, 2/22 enema complications, 2/22 naso-gastric tube complications, 1 bladder catheter complication and 1 bleeding complication from thyroid SNB sampling. Cases in group 7 did not differ significantly from the other, pooled groups according to age or medical history (data not shown).

The cases were also studied according to the common complication types in seven groups: 1) adverse drug reactions, 2) perforations (excluding vascular structures), 3) vascular injuries and other hemorrhages, 4) infections and inflammatory complications, 5) thrombosis and embolisms, 6) anastomotic leakages and suture line failures, and 7) other complications.

2.2. Statistical analyses

The age distribution was not normally distributed, and for statistics, nonparametric tests were used and median and range used in the analyses and figures unless stated otherwise. The statistical analysis was done using IBM SPSS Statistics version 25 (Armonk, NY, USA).

3. Results

Deaths related to adverse events associated with medication and known high-risk surgery, and differ according to patient age

The data consisted of 350 cases in which the manner of death was determined as iatrogenic. The material included 156 males (44.6%) and 194 females (55.4%). Mean age was 74 ± 14.2 years, median age was 76 (0–99) years. The most frequent adverse events were medication-associated (31%) and gastrointestinal surgery-associated (23%). The demographic data of the cases according to different treatment categories are presented in [Table 1](#).

In group 6 (cardiothoracic surgery), the cases were significantly younger than the median age in other groups, whereas in groups 4 (orthopedic surgery), 5 (urological procedures) and 10 (cardiological operations), they were older than in other groups ($p < 0.001$, Kruskal-Wallis test).

When the material was classified according to complication type, there were no statistically significant differences according to patient age or sex (data not shown).

Table 1
Age, sex, and the mode of death investigation according to treatment categories.

Treatment category n (%)	Age (years), median (range)	Males/ females	Mode of death investigation n (%)		
			Medico-legal autopsy	Clinical autopsy	No autopsy
All cases 350 (100.0)	76 (0–99)	156/ 194	264 (75.4)	10 (2.9)	76 (21.7)
Medication-related 108 (30.9)	76 (43–98)	42/66	75 (69.4)	3 (2.8)	30 (27.8)
Gastrointestinal surgery 79 (22.6)	73 (30–99)	37/42	73 (92.4)	0 (0.0)	6 (7.6)
Arterial surgery 26 (7.4)	73 (26–95)	14/12	20 (76.9)	0 (0.0)	6 (23.1)
Orthopedic surgery 28 (8.0)	85 (22–93)	12/16	12 (42.9)	1 (3.6)	15 (53.6)
Urological surgery 7 (2.0)	83 (74–91)	4/3	6 (85.7)	1 (14.3)	0 (0.0)
Cardiothoracic surgery 37 (10.6)	68 (0–91)	28/9	30 (81.1)	2 (5.4)	5 (13.5)
Standard small procedures 26 (7.4)	78.5 (52–91)	8/18	22 (84.6)	0 (0.0)	4 (15.4)
Gynecological surgery 3 (0.9)	77 (9–86)	0/3	3 (100.0)	0 (0.0)	0 (0.0)
Neurosurgery 10 (2.9)	73 (48–86)	2/8	5 (50.0)	1 (10.0)	4 (40.0)
Cardiological operations 15 (4.3)	85 (67–92)	5/10	13 (86.7)	0 (0.0)	2 (13.3)
Other 11 (3.1)	75 (33–98)	4/7	5 (45.5)	2 (18.2)	4 (36.4)

3.1. Patients with no previous medical history are a minority in iatrogenic deaths

There were only 42 (12.0%) cases with no prior history of significant medical conditions. The cases were younger (median age 65, range 9–99 years) than those with one (median age 75, range 0–94 years) or more (median age 79, range 27–98 years) conditions affecting the outcome. The difference was statistically significant ($p < 0.001$, Kruskal-Wallis test).

There were proportionately more cases with no previous medical history in groups 3 (arterial surgery, 19.2%), 6 (cardiothoracic surgery, 21.6%), 8 (gynecological surgery, 33.3%) and 9 (neurosurgery, 40.0%) than in the other groups (Fig. 1a). However, no such cases were observed in groups 4 (orthopedic surgery) and 5 (urological surgery). The differences were statistically significant ($p = 0.036$, chi-square test), but the number of cases in some groups was too limited to draw any reliable conclusions. There were no significant differences between groups with one and more than one chronic condition. There were no statistically significant differences between complication types according to the history of medical conditions (Fig. 1b).

3.2. Autopsy rates differ according to patient age, surgical procedure and complication type

In the majority of cases, a medico-legal autopsy had been performed (264, 75.4%). A clinical autopsy had been done in 10 (2.9%) cases, while no autopsy had been carried out in 76 (21.7%) cases. In all cases in which an autopsy (either medico-legal or clinical) was undertaken, the median age was 75 (0–99), and in those cases in which an autopsy was not done, the median age was 82 (31–98), $p < 0.001$ (Mann-Whitney). There were significant differences in the autopsy rates also between the

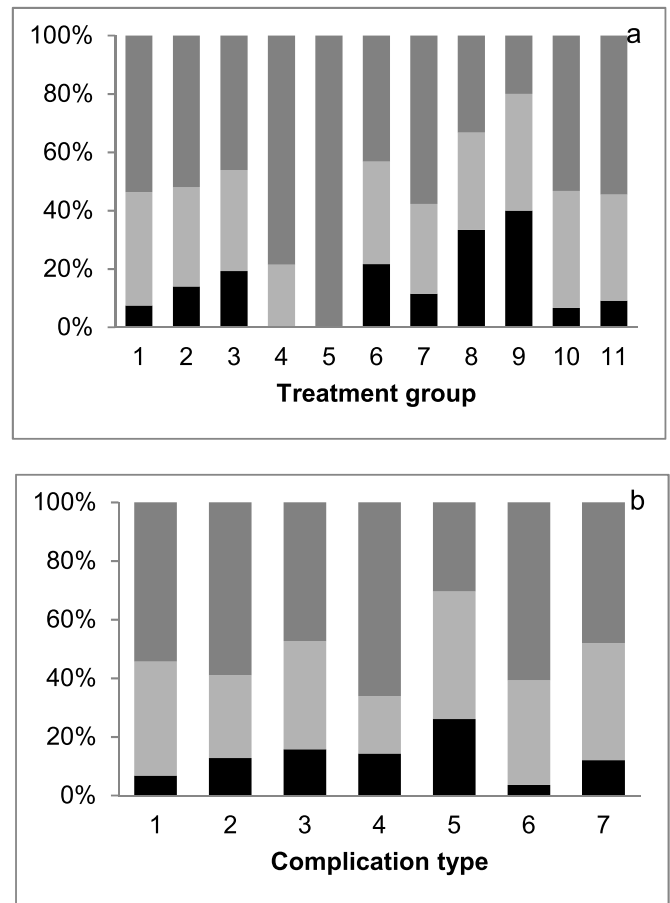


Fig. 1. The history of medical conditions in different treatment groups (a) and complication types (b). Treatment groups are: 1, medication-related; 2, gastrointestinal surgery; 3, arterial surgery; 4, orthopedic surgery; 5, urological surgery; 6, cardiothoracic surgery; 7, standard small procedures; 8, gynecological surgery; 9, neurosurgery; 10, cardiological operation; 11, other and unspecified. The complication types are: 1, adverse drug reactions; 2, perforations; 3, vascular injuries and hemorrhages; 4, infections and inflammatory complications; 5, thrombosis and embolisms; 6, anastomotic leakages and suture line failures; 7, other complications. Medical history was classified as follows: no vital indication or other immediate life-threatening condition leading to the described procedure or treatment as the cause of death, and no other chronic, serious condition affecting the outcome (black bars); vital indication or life-threatening medical condition directly related to the cause of death or other, chronic serious medical condition probably affecting the outcome (light grey bars); several medical conditions (dark grey bars).

treatment categories ($p < 0.001$, chi-square test). An autopsy, either medico-legal or clinical, was less often performed in groups 4 (orthopedic surgery), 9 (neurosurgery) and 11 (other medical or surgical treatment) than in rest of the groups. Most often a medico-legal autopsy had been carried out in the case of death caused by gastrointestinal (92.4%) and gynecological surgery (100.0%). There was also a significant difference in the autopsy rate according to the complication type ($p < 0.001$, chi-square test). A medico-legal autopsy was less often performed in infections (58.9%), adverse drug reactions (68.9%) and other complication types (56.0%) whereas all cases with anastomotic leakages had been autopsied.

4. Discussion

All in all, there were 350 deaths identified that were resulting from medical or surgical treatment or investigative procedures in the whole country during the two-year period studied. A previous study based on

national registers found only 371 deaths where the manner of death had been classified as medical treatment in 1998–2008.⁸ Compared with this, there is an almost five-fold annual increase in these deaths. The overall number of medico-legal autopsies has been rising in Finland since 2000, and now slightly declined from 2010.⁹ This trend does not explain why iatrogenic manner of death is found more often. We think that mostly this reflects the current interpretation of how iatrogenic death is defined.

It has been previously estimated that there would be 700–1,700 deaths caused by medical misadventures alone in Finland annually.⁵ These figures were based on estimations given in the United States¹⁰ and proportioned to the size of the population. Compared with our results and those of,⁸ this seems to be a gross overestimation for the Finnish population.

The incidence of preventable deaths related to adverse events has been studied in different countries. In a Dutch population, it was estimated that 1482 to 2032 potentially preventable deaths occurred in Dutch hospitals in 2004.¹¹ Dutch population is approximately three-fold of that of Finland. In a Swedish study an adverse event was recorded in 12.5% of hospital admissions, of which 3% led to death. Extrapolated to the number of hospital admissions, this would estimate over 4000 deaths related to adverse events annually.¹² The Swedish population is about two-fold of that of Finland. In a case study from the U.K., similar percentages of hospital admissions with adverse events (8.7%) were recorded, of which 10% contributed to death.¹³ The extrapolated numbers of deaths related to adverse events in these studies are much higher compared to our findings in death certificate data. Most studies on adverse events are case-studies and do not contain data on death certificates and are not fully comparable due to this. In a Norwegian study by Flaatten et al.¹⁴ the death certificate data was assessed, and in this material, the total number of deaths with adverse events was low, only 1.6% of all studied in-hospital deaths. A study that would compare data from records of hospital admissions, reported adverse events and death certificates would be beneficial in this context.

From the present data, it could not be determined how many deaths involved actual malpractice, as this assessment in the process is done by the National Supervisory Authority for Welfare and Health, not by the forensic pathologist, in contrast to other European countries.⁷ However, most of the included iatrogenic deaths were the result of unavoidable complications related, for example, to known risks of surgical procedures or an adverse drug reaction, as opposed to obvious mistakes. The total number of iatrogenic deaths comprises only less than 0.4% of deaths annually, and 1.4% of the total volume of medico-legal autopsies annually.⁹

Iatrogenic cause is quite often suspected or is the reason for police investigation and medicolegal autopsy. It has been studied previously in Ref. 15, where adverse events were suspected in a total of 9% cases sent for medicolegal autopsy. In 12% of these cases the death was determined iatrogenic, whereas in 22% of the cases, the cause of death was completely unrelated to the suspected adverse event.

Beside medication-related adverse events, the deaths caused by medical treatment were mainly related to different surgical disciplines. This was expected and is in line with previous studies.^{14,16} Gastrointestinal, cardiothoracic, orthopedic and neurosurgery were the disciplines with most adverse event-related deaths. These were also among the fields with most patient insurance claims in Finland, described in the study of Hakala et al.¹⁷ These procedures are known to have mortality risks both intra- and postoperatively, and have previously been reported to be associated with in-hospital adverse events.^{18–20} Mortality related to minor procedures included mainly thoracocentesis complications; this is a known high-risk procedure.²¹ Other low frequency cases are more or less coincidental.

The complication types are similar in different surgical procedures, and when comparing complication types, no significant differences were seen regarding patient characteristics. However, when the material was divided according to surgical disciplines, some differences were seen

that probably reflect changes in treatment culture. Certain high-risk procedures, such as transcatheter aortic valve replacement, may today be performed on older patients more often than cardiothoracic aortic valve replacement operations previously were, and this change in the treatment culture may also be reflected in this material. Some high-risk procedures, for example intracranial and carotid artery operations, may also be more often selected for younger patients with less medical history.

Only 12% of the cases had no previous significant medical history. Among these are the cases in which malpractice may be more frequent. However, malpractice claims are investigated by a different authority in Finland, and we do not have the data on how many cases were actually investigated for malpractice claims in this material.

Medico-legal autopsy was not performed in all cases in which the “manner of death” was iatrogenic. There are several reasons for this. In some cases, autopsy was not necessary since the documentation in the patient records was assessed to be sufficient for police investigation. This applies to cases in which there is no obvious mistake or a mishap. In clinically clear-cut cases of an infection or a drug reaction known to be included in the normal risk of the procedure, a medico-legal autopsy provides less often any additional information and may therefore not be necessary. The autopsy rate of the clear-cut iatrogenic deaths might vary. It could be studied during a longer time interval if the autopsy rate varies from the 75% seen in this study. In some cases, the system did not work properly: the death certificate was drawn up and the manner of death classified as “disease-related”, and later sent to the Finnish Institute for Health and Welfare to be assessed by a forensic specialist, who reclassified the case as iatrogenic. There were 4% of such reclassified cases in this material.

There are no clear national guidelines for how a treatment-related adverse event should be determined. If a medical treatment is given prior to death and suspected to have affected the outcome, the cases are consulted and discussed often with the police and with a forensic specialist. The logic is similar of that described in Ref. 22. The cases fall mainly into three categories: death due to natural disease, in which the given medical therapy plays no role in causing the death, or death due to predictable, known complications of appropriate medical therapy (therapeutic complication), or death due unanticipated complications and/or inappropriate therapies. The cases that fit in the first category, where the medical therapy given does not affect the outcome, are most often considered disease-related and not sent for autopsy. The cases that present with predictable, known complications of certain therapies (i.e. high-risk cardiothoracic or abdominal surgery), are often, but not always sent for autopsy. If the manner of death can be clearly judged by the information that the clinician provides, autopsy might not be necessary, as it was in 25% of cases in this material. The cases in the third category that present with unanticipated complications or have received inappropriate therapies, should always be sent for autopsy.

Adverse events related to a possible delay in the treatment and/or wrong diagnoses do not come out in this material using death certificate data, since they are classified as disease-related deaths. The authority that assesses the adequacy of the treatment is separated from the cause of death investigation. The National Supervisory Authority for Welfare and Health investigates all cases in which a suspected adverse event has led to death while other cases with malpractice claims are studied in Regional State Administrative Agencies. It would be useful to extend the study and to compare statistics from these authorities to death certificate statistics. However, international comparison is still difficult due to differences in legislation and the role of different organizations in the process, despite all of them aiming in at a similar systematic approach with malpractice claims.⁷

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CRedit authorship contribution statement

Paula Kuvaja: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Noora Keinänen:** Data curation, Formal analysis, Methodology, Writing – original draft. **Lasse Pakanen:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript

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References

- Gay J, et al. *Mortality Amenable to Health Care in 31 OECD Countries: Estimates and Methodological Issues*. OECD Health Working Papers; 2011. <https://doi.org/10.1787/5kgj35f9f8s2-en>.
- Nolte E, McKee M. *Does Health Care Save Lives? Avoidable Mortality Revisited*. The Nuffield Trust; 2004;139, 1902089944 Downloaded from: <http://researchonline.lsh.tm.ac.uk/15535/>.
- Classen DC, Resar R, Griffin F, et al. Global trigger tool' shows that adverse events in hospitals may be ten times greater than previously measured. *Health Aff*. 2011;30:581–589.
- Roine R, Kinnunen M, Haavisto E. Potilasturvallisuudesta on liian vähän tietoa. *Suomen lääkäri*. 2017;3:108–109.
- Pasternak A. Hoitovirheet ja hoidon aiheuttamat haitat. *Duodecim*. 2006;122:2459–2470.
- Järvelin J, Haavisto E, Kaila M. Potilasturvallisuuden kustannukset. *Suomen lääkäri*. 2010;65:1123–1127.
- Ferrara SD, et al. EALM working group on medical malpractice. Malpractice and medical liability. European guidelines on methods of ascertainment and criteria of evaluation. *Int J Leg Med*. 2013;127:545–557.
- Manderbacka K, Sund R, Ruuth I, et al. Miten löytää terveydenhuollon häiritäpähtymät kuolemansyyrekisteristä? *Suom Laakaril*. 2012;67:789–793.
- Official Statistics of Finland (OsF). Causes of death [e-publication]. ISSN=1799-5078. Helsinki: Statistics Finland [referred: 17.12.2021]. Access method: http://www.stat.fi/til/ksyyt/meta_en.html.
- Kohn LT, Corrigan JM, Donaldson MS, eds. *Institute of Medicine (US) Committee on Quality of Health Care in America. To Err Is Human: Building a Safer Health System*. Washington (DC): National Academies Press (US); 2000.
- Zegers M, de Bruijne MC, Wagner C, et al. Adverse events and potentially preventable deaths in Dutch hospitals: results of a retrospective patient record review study. *Qual Saf Health Care*. 2009;18:297–302.
- Soop M, Fryksmark U, Köster M, Haglund B. The incidence of adverse events in Swedish hospitals: a retrospective medical record review study. *Int J Qual Health Care*. 2009;21:285–291.
- Sari AB, Sheldon TA, Cracknell A, et al. Extent, nature and consequences of adverse events: results of a retrospective casenote review in a large NHS hospital. *Qual Saf Health Care*. 2007;16:434–439.
- Flaatten H, Brattebø G, Alme B, et al. Adverse events and in-hospital mortality: an analysis of all deaths in a Norwegian health trust during 2011. *BMC Health Serv Res*. 2017;17:465.
- Pakanen L, Keinänen N, Kuvaja P. Presumed adverse events in health care are a frequent indication for medico-legal autopsy in Finland. *Forensic Sci Med Pathol*. 2020;16:65–70.
- Madea B, Preuss J. Medical malpractice as reflected by the forensic evaluation of 4450 autopsies. *Forensic Sci Int*. 2009;190:58–66.
- Hakala T, Vironen J, Karlsson S, Pajarinen J, Hirvensalo E, Paajanen H. Fatal surgical or procedure-related complications: a Finnish registry-based study. *World J Surg*. 2014;38:759–764.
- Kalaitzakis E. All-cause mortality after ERCP. *Endoscopy*. 2016;48:987–994.
- Rai V, Mishra N. Colonoscopic perforations. *Clin Colon Rectal Surg*. 2018;31:41–46.
- de Vries EN, Ramrattan MA, Smorenburg SM, Gouma DJ, Boermeester MA. The incidence and nature of in-hospital adverse events: a systematic review. *Qual Saf Health Care*. 2008;17:216–223.
- Cantey EP, Walter JM, Corbridge T, Barsuk JH. Complications of thoracentesis: incidence, risk factors, and strategies for prevention. *Curr Opin Pulm Med*. 2016;22:378–385.
- McGuire AR, DeJoseph ME, Gill JR. An approach to iatrogenic deaths. *Forensic Sci Med Pathol*. 2016;12:68–80.