







ORIGINAL RESEARCH

# Characterization of autopsies performed at a Peruvian national hospital. 1993-2022

*Caracterización de autopsias en un hospital nacional de Perú. 1993- 2022*

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## Abstract

**Introduction:** An autopsy is a procedure that allows determining the cause of death. A decrease in clinical autopsies has been reported in several countries.

**Objective:** To describe the characteristics, including diagnostic findings and trends, of medical autopsies performed at a national hospital in Peru between 1993 and 2022.

**Materials and methods:** Descriptive study performed using data from 943 autopsies (nonviolent deaths) obtained from the autopsy registry of the Hospital Nacional Arzobispo Loayza (Lima, Peru). The annual proportion of autopsies was calculated for the periods 1993-1997 and 2005-2022. A trend analysis of the annual proportion of autopsies was performed using the Spearman rank correlation coefficient, considering a statistical significance value of  $p < 0.05$ .

**Results:** Autopsies were more frequent in women (55.04%) and older adults (27.78%). Furthermore, 50.16% of the autopsies were performed partially, and 48.46% of the patients died in the internal medicine inpatient service. The most frequent diagnostic findings were respiratory system diseases (19.25%), digestive system diseases (15.73%), and infectious/parasitic diseases (10.27%). The absolute frequency of autopsies showed an overall downward trend (95 autopsies in 1996, 47 in 2003, and 6 in 2022). On the other hand, the annual proportion of autopsies showed an increasing trend between 1993 and 1995 (6.17% vs. 9.44%;  $Rho = 0.50$ ;  $p = 0.667$ ), although this proportion decreased in 1997 (9.44% vs. 4.75%). In the period 2005-2022, an overall downward trend was observed (1.62% vs. 0.35%;  $Rho = -0.85$ ;  $p < 0.001$ ).

**Conclusion:** The frequency of autopsies showed an overall downward trend between 1993 and 2022.

Moreover, autopsies were performed more frequently in women, older adults, and patients who died in the internal medicine inpatient service.

## Resumen

**Introducción.** La autopsia es un procedimiento que permite determinar las causas de la muerte. En varios países se ha reportado un descenso en la cantidad de autopsias clínicas.

**Objetivo.** Realizar una caracterización, incluyendo hallazgos diagnósticos y tendencias, de las autopsias médicas realizadas en un hospital nacional de Perú entre 1993 y 2022.

**Materiales y métodos.** Estudio descriptivo realizado con datos de 943 autopsias (muertes no violentas) obtenidos del registro de autopsias del Hospital Nacional Arzobispo Loayza (Lima, Perú). Se calculó la proporción anual de autopsias para los periodos 1993-1997 y 2005-2022. El análisis de tendencia de la proporción anual de autopsias fue realizado mediante el coeficiente de correlación de Spearman; se consideró un valor de significancia estadística de  $p < 0.05$ .

**Resultados.** Las autopsias fueron más frecuentes en mujeres (55.04%) y adultos mayores (27.78%). Además, 50.16% de las autopsias fueron parciales y 48.46% de estos pacientes fallecieron en el Servicio de Hospitalización de Medicina Interna. Los hallazgos diagnósticos más frecuentes fueron enfermedades del sistema respiratorio (19.25%), enfermedades del sistema digestivo (15.73%) y enfermedades infecciosas/parasitarias (10.27%). La frecuencia absoluta de autopsias mostró una tendencia general decreciente (95 autopsias en 1996, 47 en 2003 y 6 en 2022). Por otra parte, la proporción anual de autopsias mostró una tendencia ascendente entre 1993 y 1995 (6.17% vs 9.44%;  $Rho = 0.50$ ;  $p = 0.667$ ), aunque dicha proporción disminuyó en 1997 (9.44% vs. 4.75%). En el periodo 2005-2022, se observó una tendencia general decreciente (1.62% vs. 0.35%;  $Rho = -0.85$ ;  $p < 0.001$ ).

**Conclusión.** La frecuencia de autopsias mostró una tendencia general decreciente entre 1993 y 2022. Además, las autopsias se realizaron con mayor frecuencia en mujeres, adultos mayores y pacientes que fallecieron en el Servicio de Hospitalización de Medicina Interna.

## Introduction

The term autopsy is derived from the Greek words *autos* and *opsis* and means “to see for oneself”.<sup>1</sup> This procedure is performed to establish the causes and forms of death, as well as the diseases or injuries involved.<sup>2</sup> An autopsy also provides essential information for quality control of medical care and for improving the quality of information on the cause of death reported on the death certificate. Likewise, it plays a fundamental role in the medicolegal investigation of deaths, medical education, and health research.<sup>3-5</sup> However, a decrease in the rate of clinical autopsies has been reported, mainly because of the attitudes of health care personnel, relatives of the deceased, and health insurance companies regarding the costs of this procedure.<sup>6</sup>

For example, in developed countries, this decrease in autopsy rates has been reported in the United States, where the rate went from 19.1% in 1972 to 7.4% in 2020;<sup>7</sup> in Australia, where a study performed in local hospitals found that the proportion of autopsies decreased significantly between 1978 (47%) and 2015 (1.4%);<sup>8</sup> and in the United Kingdom, where a research that analyzed data from hospitals reported a clear decrease in the frequency of autopsies and also stated that 23% of the included hospitals did not even perform autopsies in 2013.<sup>9</sup>

In Latin America, several authors have also noted this situation. For example, a study conducted in 32 teaching hospitals affiliated with medical schools and residency programs in Brazil found that 46.9% of the institutions surveyed reported a decrease in the number of academic autopsies between 2003 and 2008.<sup>5</sup> Likewise, according to a study carried out in a university hospital in Mexico with data for the period 1954-2009, despite observing an upward trend in the number of autopsies performed in the hospital between 1954 and 1969, there is a downward trend in the number of autopsies performed from 1978 to 2008. Furthermore, it should be pointed out that according to that study, of the 4 663 patients who died in the hospital in the period 2004-2008, only 315 (6.7%) underwent autopsies, i.e., a rather low frequency of autopsies, with a decrease in both the number and frequency of autopsies performed between 2004 and 2008 (n=71 and 7.9% vs. n=64 and 7.5%).<sup>10</sup> In Peru, based on a recent search of the literature, there are no studies that provide data on the performance of autopsies in hospitals in terms of frequency and trends, either upward or downward, at least not in the general population.

It is well known that the causes of death identified in autopsies vary depending on the age group and/or the presence of comorbidities. In this regard, Mendoza *et al.*,<sup>11</sup> in a study conducted in patients who died due to non-violent reasons in a hospital in Colombia between 2012 and 2015, reported that the following were the main causes of death for each age group: congenital disorders in stillbirths; pneumonia and other respiratory conditions in neonates and infants; pneumonia and associated respiratory disease in the pediatric population aged 2-17 years; cardiac arrest associated with acute myocardial infarction, cardiomyopathies, or cardiovascular defects in adults aged 18-64 years; and cardiovascular disease in older adults (>65 years). As for the presence of comorbidities, for instance, according to a study that analyzed data from autopsies of HIV-positive patients performed in a Peruvian hospital between 1999 and 2004, opportunistic infections were the most frequent cause of death, mainly disseminated infectious diseases.<sup>12</sup>

The Hospital Nacional Arzobispo Loayza (HNAL) is one of the oldest hospitals in Peru with a history of more than 100 years<sup>13</sup> and the second largest hospital in the country, with 830 hospital beds.<sup>14</sup> The hospital, located in the city of Lima, provides health care services to a considerable number of patients in the Outpatient Service, with 2016 being the year in which the highest number of visits was registered (n=624 934); additionally,

patients from all regions of Peru are referred to its different inpatient services.<sup>15</sup> Given these characteristics, it is possible to state that the HNAL is a representative hospital at the national level.

Considering the above, the objective of this study was to describe the characteristics of the autopsies performed at the HNAL between 1993 and 2022.

## Materials and methods

### Study type

Descriptive study.

### Data used

Data from autopsies performed at the HNAL between 1993 and 2022 (n=943) were analyzed. The information was obtained from the autopsy record book of the hospital's Department of Anatomic Pathology.

### Procedures and variables

Based on the review of the autopsy record book, information on the following variables was obtained: sex, age, inpatient service or hospital unit where the patient died, type of autopsy, and diagnostic findings during autopsy. It is worth noting that this information was reviewed and transcribed independently by 3 of the authors (JSRR, AEHP and ACSC) in a database created in Microsoft Excel© and that the final database was created based on a review of these 3 databases; discrepancies were resolved by consensus.

Diagnostic findings were categorized according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10).<sup>16</sup> Age groups were classified according to the Target Groups for the Peruvian Ministry of Health's Comprehensive Care Programs into children (0-11 years), adolescents (12-17 years), young adults (18-29 years), adults (30-59 years), and older adults (>60 years);<sup>17</sup> the category of fetal death was also added for intrauterine death records.

This study only includes data from autopsies of individuals who died in the hospital from non-violent causes, because in Peru, since 1991 and in accordance with current legislation, in the event of violent death, once the body has been removed by an official of the Public Prosecutor's Office, a medicolegal autopsy must be performed by the pertinent authorities.<sup>18-20</sup>

### Statistical analysis

Data are described using absolute and relative frequencies for qualitative variables and medians and interquartile ranges (IQR) for quantitative variables since the data did not show a normal distribution (Shapiro-Wilk test).

The annual proportion of autopsies was estimated by dividing the total number of autopsies performed by the total number of hospital deaths recorded each year. Information on the number of hospital deaths per year was obtained from the hospital's *Análisis de Situación de Salud* or *ASIS* (Health Situation Analysis) reports (period 2005-2022)<sup>21</sup> and from the *Loayza en cifras* (Loayza in Figures) yearbook (period 1993-1997).<sup>22</sup> The HNAL's *ASIS* documents began to be systematically produced since 2005 by the hospital's Epidemiology

Office and are available in physical format for the period 2005 to 2013 and in digital format from 2014 onwards,<sup>21</sup> while the *Loayza en cifras* yearbook was published as a one-off and is available online.<sup>22</sup> Taking into account the foregoing, it was not possible to estimate the annual proportion of autopsies for the period 1998-2004 because we were unable to obtain data on the total number of patients who died in the hospital during this lapse.

The annual proportion of autopsies and the absolute frequency of autopsies are presented using a trendline graph. The trend analysis of the annual proportion of autopsies for the periods 1993-1997 and 2005-2022 was done using the Spearman correlation coefficient (Rho), considering a statistical significance value of  $p<0.05$ .

Ethical considerations

Although secondary data were used, the research was conducted following the ethical principles of biomedical research established by the Council for International Organizations of Medical Sciences, the World Medical Association, and the Peruvian General Health Law.<sup>23-25</sup> Moreover, since the autopsy record book must contain the personal information of the patients, when the information was entered into the database used in the study, a numerical value was assigned to each of the records in order to guarantee the anonymity of their data.

Results

Of 943 autopsies, 55.04% (n=519) were performed in women and no data on sex were reported in 27.68% (n=261). The median age was 48 years (IQR: 24-49); when stratified by age group, the following was found: the median age was 0.90 days in children [IQR: 0.30-510], 16 years in adolescents [IQR: 14.00-16.00], 24 years in young adults [IQR: 21.00-26.00], 46 years in adults [IQR: 38.00-53.00], and 73 years in older adults [IQR: 67.00-81.00]. Autopsies were more frequent in older adults (27.78%; n=262) and adults (24.18%; n=228). In addition, 48.46% (n=457) of these patients died at the internal medicine inpatient service ward and 50.16% (n=473) of the autopsies were partial (Table 1).

On the other hand, respiratory system diseases were the most frequent diagnostic finding (34.78%; n=328), followed by digestive system diseases (28.42%; n=268), and infectious/parasitic diseases (18.56%; n=175) (Table 1).

**Table 1.** Characteristics of autopsies performed at the Hospital Nacional Arzobispo Loayza between 1993 and 2022 (n=943).

Characteristics	n=943	%
Sex		
Female	519	55.04
Male	163	17.28
No data	261	27.68
Type of autopsy		
Partial	473	50.16
Total	438	46.45
No data	32	3.39

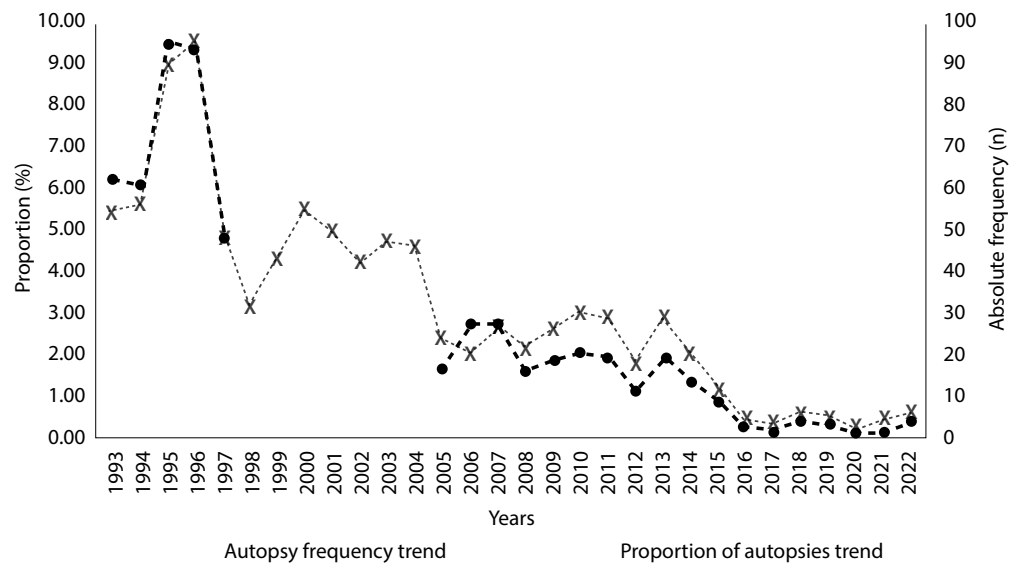
**Table 1.** Characteristics of autopsies performed at the Hospital Nacional Arzobispo Loayza between 1993 and 2022 (n=943). (Continued)

Characteristics	n=943	%
<b>Age group</b>		
Stillbirth	43	4.56
Child	225	23.86
Adolescent	13	1.38
Youth	87	9.23
Adult	228	24.18
Older adult	262	27.78
No data	85	9.01
<b>Inpatient department or unit of the hospital where the patient died</b>		
Surgery	24	2.55
Emergency Room	55	5.83
Obstetrics and Gynecology	23	2.44
Internal Medicine	457	48.46
Neonatology	224	23.75
Pediatrics	16	1.70
Intensive Care Unit	106	11.24
No data	38	4.03
<b>ICD-10 diagnostic findings *</b>		
Diseases of the respiratory system	328	34.78
Diseases of the digestive system	268	28.42
Certain infectious and parasitic diseases	175	18.56
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	165	17.39
Diseases of the circulatory system	153	16.22
Malignant neoplasms	151	16.01
Certain conditions originating in the perinatal period	119	12.51
Congenital malformations, deformities and chromosomal abnormalities	95	10.07
Diseases of the genitourinary system	84	8.91
Diseases of the nervous system	83	8.80
Endocrine, nutritional and metabolic diseases.	22	2.33
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	19	2.01
Diseases of the musculoskeletal system and connective tissue	10	1.06
Diseases of the skin and subcutaneous tissue	10	1.06
Pregnancy, childbirth and puerperium	7	0.74
Injury, poisoning and certain other consequences of external causes	4	0.42
Factors influencing health status and contact with health services	3	0.32
Diseases of the eye and adnexa	2	0.21
No data	82	8.70

ICD-10: International Statistical Classification of Diseases and Related Health Problems.

\* It should be noted that a single autopsy may report several diagnostic findings.

Regarding the annual proportion of autopsies, we found that between 1993 and 1995 there was an upward trend (6.17% vs. 9.44%;  $Rho=0.50$ ,  $p=0.667$ ), but then there was a decrease until 1997 (4.75%); between 2005 and 2022 the overall trend was downward (from 1.62% in 2005 to 0.35% in 2022;  $Rho=-0.85$ ,  $p<0.001$ ); and the annual proportion of autopsies was lower in the period 2005-2022 than in the period 1993-1997 (0.09%-2.80% vs. 4.75% vs. 9.44%). Concerning the absolute annual frequency of autopsies, a similar decreasing behavior was observed (95 autopsies in 1996, 47 in 2003, and 6 in 2022) (Figure 1).



**Figure 1.** Absolute annual proportions and frequencies of autopsies performed at the Hospital Nacional Arzobispo Loayza. 1993-2022.

## Discussion

In the present study, we found that autopsies were performed more frequently in women (55.04%) and in older adults (27.78%). These findings differ from those reported by Santana *et al.*<sup>26</sup> in a study carried out with data from 17 914 autopsies (violent and nonviolent causes) performed in a Cuban hospital between 1983 and 2020, in which 52% were performed in men and 46.6% in individuals over 65 years of age. Our findings also differ from a study by Humez *et al.*<sup>27</sup> that included data from 412 autopsies (all nonviolent deaths) performed in university hospitals in two French cities between 2007 and 2012, in which 60% were performed in males and half of them in pediatric patients. The higher frequency of autopsies in women at the HNAL may be explained by the fact that our hospital has historically served a predominantly female population, which accounted for 76.2% of all patients treated at the outpatient service in 1996 (22) and 67.8% of outpatient users in 2022.<sup>15</sup>

The most frequent diagnostic findings were diseases of the respiratory system (34.78%), diseases of the digestive system (28.42%), and infectious/parasitic diseases (8.56%). Although the objective of our research was not to study the cause of death, these diagnostic findings have been reported as causes of death in similar studies such as the one by Mendoza *et al.*,<sup>11</sup> which was carried out utilizing data from 747 autopsies of patients who died for nonviolent reasons between 2012 and 2015 in a hospital in Colombia, where the main causes of death were acute myocardial infarction ( $n=155$ , 20.74%), other conditions (pulmonary aspiration, sepsis secondary to urinary tract infections, gastrointestinal



infections, and rare conditions;  $n=126$ , 16.86%), and bacterial pneumonia associated with respiratory diseases ( $n=122$ , 16.33%). Similarly, Santana *et al.*<sup>26</sup> analyzed data from 17 914 autopsies (violent and nonviolent deaths) performed in a Cuban hospital between 1983 and 2020 and reported that the main direct morphologic causes of death were bronchopneumonia (15.9%), multiple metastases (15.9%), multiorgan dysfunction (11.1%), pulmonary thromboembolism (8.4%), and pulmonary edema (8.4%). Finally, Erlmeier *et al.*,<sup>28</sup> in a study including 2 183 autopsies of nonviolent deaths performed between 2005 and 2014 in two university hospitals in Germany, reported that the main causes of death were cardiac or circulatory diseases (50.80%), respiratory diseases (22.40%), systemic hematological diseases (16.10%), brain diseases (5.80%), and digestive tract diseases (3.60%).

The absolute frequency of autopsies at the HNAL showed a downward trend between 1995 and 2022, decreasing from 90 in 1995 to 6 in 2022. These results are similar to those reported in studies performed in hospitals in North America and Europe. For example, in the study by Marshall *et al.*,<sup>29</sup> which included data of 923 autopsies performed between 2009 and 2014 in a hospital in the United States, a downward trend was observed, going from 204 autopsies in 2009 to 137 in 2014. Similarly, in the research of Rey-Fanjul *et al.*,<sup>30</sup> who analyzed reports of 692 adult autopsies performed between 2008 and 2017 at a university hospital in Spain, a general downward trend is evident (86 autopsies in 2008 vs. 49 in 2017).

Along the same lines, Friberg *et al.*,<sup>31</sup> in a study that included data from autopsies performed on adult patients who died of nonviolent causes at two university hospitals in Sweden between 1999 and 2000 and between 2009 and 2010, reported that the absolute frequency of autopsies decreased from 1 357 in the period 1999-2000 to 1 053 in 2009-2010 (a reduction of 22.4%).

Lastly, the study conducted by Erlmeier *et al.*<sup>28</sup> also indicates a downward trend in the annual number of autopsies performed (243 in 2005 vs. 167 in 2014), which, in turn, contrasts with the upward trend in the number of deceased patients (1631 in 2005 vs. 1909 in 2014), resulting in a dramatic reduction in the annual proportion of autopsies performed at the two hospitals where the study was conducted (14.90 vs. 8.75%). However, it is worth noting that even though Santana *et al.*<sup>26</sup> reported a downward trend, the average proportion of autopsies in the study period (1983-2019) was 81.6%.

With respect to the annual proportion of autopsies at the HNAL during the study periods, in general, the proportion was low, with a marked decline over time, taking into account that although there was an upward trend (6.17% vs. 9.44%) between 1993 and 1995, there was a decrease in 1997 (4.75%) and a downward trend from 2005 to 2022 (1.62% in 2005 vs. 0.35% in 2022). While the low annual proportion of autopsies in inpatients dying of nonviolent causes and the downward trend over time observed in our study are findings consistent with the existing literature,<sup>7-10,28</sup> it could be said that the figures observed at the HNAL in the period 2005-2022 (0.09% -2.80%), although within the range, are generally lower than those reported in similar studies.<sup>7-10,28</sup> Accordingly, Paratz *et al.*<sup>32</sup> in a systematic review that aimed to quantify the actual global autopsy rates in cases of all-cause deaths and young sudden death, noted that 59 out of 195 countries (30.3%) reported data on autopsy rates of all-cause deaths with rates between 0.01 and 83.9% and an overall rate of 6.7%; furthermore, according to these authors, in 62.7% of these countries, the proportion of autopsies was <10%.<sup>32</sup>

The downward trend in the annual proportion of autopsies observed both in our hospital and in the studies described above could be related to less emphasis on autopsy in medical education, advances in premortem diagnostic techniques, reluctance of the deceased's

relatives, failure of pathologists to communicate diagnostic findings, and considering medical autopsy as an outdated, costly and underestimated procedure, despite its usefulness as a tool for quality control of medical care and the cause of death recorded on the death certificate.<sup>33-35</sup> Notwithstanding the above, medical autopsies have proven to provide an unparalleled opportunity for studying current health problems such as cancer<sup>35,36</sup> and understanding the clinical characteristics of new infections such as COVID-19.<sup>37</sup>

As for the HNAL service or unit where the patients who underwent autopsies during the study periods died, we found that the internal medicine (48.46%) and neonatology (23.75%) inpatient services were the most frequent. These results are similar to those reported by Joubert *et al.*<sup>38</sup> in a study that analyzed the characteristics of 288 autopsies (nonviolent causes) performed between 2014 and 2017 in two tertiary care hospitals in Pretoria (South Africa), where most patients had been treated by the internal medicine (46.20%) and pediatrics services, including neonates (21.90%). However, they differ from the findings of Humez *et al.*,<sup>27</sup> who found that pediatrics was the service that requested the most autopsies (46.8%), followed by emergency or intensive care units (31.3%); the study by Humez *et al.*,<sup>27</sup> did not include autopsies of stillbirths or sudden infant death (neonatology).

The main limitation of the present study is the use of a secondary data source. Another limitation was the heterogeneity with which the pathology physicians reported diagnostic findings in the hospital autopsy record book (23 physicians). However, to overcome this, three of the authors (JSRR, AEHP and ACSC) transcribed the information separately and met to resolve inconsistencies by consensus, using ICD-10 codes to standardize the information.

The third limitation is that the variables direct cause, intervening cause, and basic cause of death were not considered, since neither the medical records nor the autopsy protocol in extenso were available for more than 95% of the cases due to deterioration of the documents and/or deficiencies in their storage. We therefore recommend conducting studies on the implementation of electronic systems for recording autopsy data in hospitals to prevent data loss.

Finally, the causes of the downward trend in the annual number of autopsies performed in the hospital were not explored, which is essential to develop strategies aimed at changing it. Consequently, we recommend conducting studies, both in Peru and Latin America, to find out the possible causes, especially the attitudes of clinicians and relatives of deceased patients towards autopsies.

On the other hand, the main strength of our study is that it is the first to provide data on the frequency, trend, and diagnostic findings of autopsies in the general population in a national hospital in Peru. Another strength is that it was conducted at a national reference hospital, which means that it receives patients from all regions of Peru. Finally, the period covered by the study is 30 years and includes more than 900 autopsy records, allowing a broad understanding of the study problem.

## Conclusions

The absolute frequency of autopsies at the HNAL showed a downward trend between 1993 and 2022. Moreover, the main diagnostic findings were diseases of the respiratory system, diseases of the digestive system, and infectious/parasitic diseases. Finally, autopsies were performed more frequently in women, older adults, and patients who died in the internal medicine inpatient service ward.

## Conflicts of interest



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