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BMJ Open Inpatient autopsy rate and associated factors in a Chinese megacity: a population-based retrospective cohort study

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ABSTRACT

Objectives This study investigated the autopsy rate of hospital deaths in Shenzhen megacity and identified factors that may impact the decision to perform an autopsy in hospital deaths.

Design This is a population-based retrospective cohort study.

Setting Shenzhen is a megacity in China with a population of more than 17 million and a total of 151 hospitals. The official dataset of the inpatient medical record home page was used. Demographic, clinical and hospital information was extracted.

Participants All the 35 272 inpatient deaths between 2016 and 2022 with known autopsy status were included to calculate the overall autopsy rate. Among them, a total of 34 577 cases with complete data, classified hospital and Chinese nationality, were included for further multivariable rare events logistic regression and Poisson pseudo maximum likelihood regression.

Outcome measures Whether the inpatient death was autopsied or not.

Results The autopsy procedure was performed in 0.9% (319/35 272) of hospital deaths. The autopsy decision was significantly and positively associated with being married (OR=1.60, 95% CI: 1.16 to 2.21), self-paying (OR=1.56, 95% CI: 1.07 to 2.26), death due to external causes of injury and poisoning (OR=1.69, 95% CI: 1.02 to 2.81) and pregnancy (OR=13.58, 95% CI: 4.94 to 37.36), but negatively associated with age (OR=0.97, 95% CI: 0.96 to 0.98), emergency admission (OR=0.66, 95% CI: 0.49 to 0.88), referral (OR=0.47, 95% CI: 0.25 to 0.88), neoplasms (OR=0.35, 95% CI: 0.22 to 0.56), respiratory diseases (OR=0.49, 95% CI: 0.26 to 0.95) and for-profit hospitals (OR=0.45, 95% CI: 0.23 to 0.91). There were no statistically significant differences in autopsy rates between large teaching hospitals and other hospitals.

Conclusions The autopsy rate of hospital deaths was extremely low, largely due to healthcare providers. Even large teaching hospitals do not request more autopsies compared with other hospitals, after controlling for the patient characteristics. More efforts are urged to encourage hospitals and healthcare providers to proactively request autopsies, helping to revive this important procedure.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is a population-based retrospective cohort study in a megacity over 7 years.
- ⇒ Demographic, clinical and hospital factors were included in the multivariable analysis, enabling a comprehensive exploration of factors associated with autopsy.
- ⇒ Rare events logistic regression was used to minimise the biases associated with extremely low autopsy rate, and Poisson pseudo maximum likelihood regression was employed for a robustness check.
- ⇒ Information on the type (clinical/legal) of each autopsy was lacking.
- ⇒ The autopsy rate of this megacity may not be representative of the entire country due to the large urban–rural disparities in China.

INTRODUCTION

Autopsy plays a fundamental role in revealing pathological findings in advanced illness and rare conditions, identifying emerging and re-emerging diseases, ensuring local quality control through antemortem diagnoses and providing more accurate vital statistics.^{1 2} Despite the importance of the autopsy, the autopsy rate has declined globally in recent decades.^{3–5} The reported median rate of autopsy was 6.7% worldwide in the period of 2000–2023.⁶

The Chinese government has not provided publicly accessible data of autopsy rates. The only data available in the literature were some reports from individual institutions. The autopsy rates have sharply declined, according to the limited data of Chinese large hospitals. A review article showed that the autopsy rate in several Chinese teaching hospitals reached more than 50% in the 1950s but dropped dramatically since the 1970s. The mean autopsy rate of these hospitals during the 1950s to 1980s ranged from 10% to 20%. Between 1998 and 2008, the

autopsy rates in five prominent teaching hospitals in China varied from 0.04% to 2.04%.⁷ The current available autopsy rate (1.0%) in China of a global report was obtained from these data of the five teaching hospitals in this review article, which may not be representative.⁶ The lack of attention to autopsies has already weakened the healthcare system and the society. For example, during the pandemic of COVID-19, no autopsy was performed on COVID decedents until more than 1500 deaths had occurred, which was 1 month after the first reported death.⁸⁻⁹ If autopsies of COVID decedents had been conducted earlier, China and other countries would have gained a better understanding of this emerging disease in its initial stage.¹⁰

The decision of autopsy is highly influenced by culture and policies and deserves further discussion in different countries.³⁻¹¹ In China, there is no coroner system or medical examiner system similar to those in the UK or the USA. According to Chinese law, in criminal cases, an autopsy may be performed with the approval of the person in charge of the national security authority, no matter whether the family agrees or not.¹² In non-criminal cases, if there is a disagreement between the family and medical staff over the cause of death, an autopsy should be conducted. Under this circumstance, the autopsy must be approved and signed by the deceased's close relatives. If there is a refusal or delay in performing the autopsy, resulting in an impact on determining the cause of death, the party responsible for the refusal or delay will bear the legal consequences.¹³ As a result, doctors routinely ask the deceased's close relatives for their consent to perform an autopsy and document their response to avoid lawbreaking. On the other hand, there is currently no requirement for hospitals or doctors to promote autopsies for quality control or medical inquiry purposes. Back in 1989, the National Hospital Management Grading Standards stipulated that the autopsy rate for tertiary hospitals should be more than 15%. However, this requirement was later abolished, as very few hospitals were able to meet this criterion.¹⁴

Like all cultures, Chinese culture has a unique perspective on death, shaped by influences from Taoism, Confucianism and Buddhism.¹⁵ Death is considered one of the biggest taboo topics among Chinese people. Although most people in mainland Chinese cities are cremated after they die, they still place great importance on whether a complete body is left after death. A national survey showed that the public expressed concerns about body disfigurement following an autopsy, and their perceptions of autopsies were often inaccurate and prejudicial.¹⁶

The factors that contribute to the decision on whether an autopsy will be performed have been studied in some developed Western countries but were rarely analysed in low- and middle-income countries such as China.¹⁷⁻¹⁹ Furthermore, some previous studies that explored the associated factors of autopsy primarily relied on bivariate analyses such as χ^2 and correlations, which may not be sufficiently comprehensive.²⁰⁻²⁴

The aims of this study were to: (1) investigate the autopsy rate of hospital deaths in Shenzhen megacity; (2) identify factors that may impact the decision to perform an autopsy in hospital deaths and thereby influence the autopsy rate in the future.

METHODS

In compliance with the requirements of the Shenzhen Health Development Research and Data Management Centre, all the records were anonymised before data extraction. This article adheres to the Strengthening the Reporting of Observational Studies in Epidemiology guideline.

Setting

Shenzhen is a city and special economic zone bordering Hong Kong to the south. It is a global centre in technology, research, manufacturing and transportation. It has a reputation as China's Silicon Valley. With a population of more than 17 million, Shenzhen is the third most populous city by urban population in China after Shanghai and Beijing. This population number exceeds many countries in Europe or Oceania.

Data source

The data used in this study were obtained from the home page of the inpatient medical record dataset provided by the Shenzhen Health Development Research and Data Management Centre. Established in 2021, this organisation is affiliated to the Health Commission of Shenzhen Municipality. This dataset contains all the information on the home page of inpatient medical records in Shenzhen, and the earliest data were from 1 January 2016.

Inclusion and exclusion

All the inpatient deaths between 2016 and 2022 were included. After the overall and annual autopsy rates were calculated, cases with incomplete data, unclassified hospital or foreign nationality were excluded for further multivariable analysis (figure 1).

Measures

The outcome variable for this study was whether an autopsy had been performed on each decedent (1=yes, 0=no). The explanatory variables were categorised into three groups: (1) demographic factors: gender, age, ethnicity, marital status and medical insurance; (2) clinical factors: hospital admission pathway, length of stay, department, main diagnosis at discharge and external causes of injury and poisoning; (3) hospital factors: hospital level and hospital type. Age was treated as a continuous variable, while others were categorical variables. The main diagnosis at discharge was classified based on the International Classification of Diseases, 10th Revision (table 1). External causes of injury and poisoning were separate items recorded on the home page of the inpatient medical record.

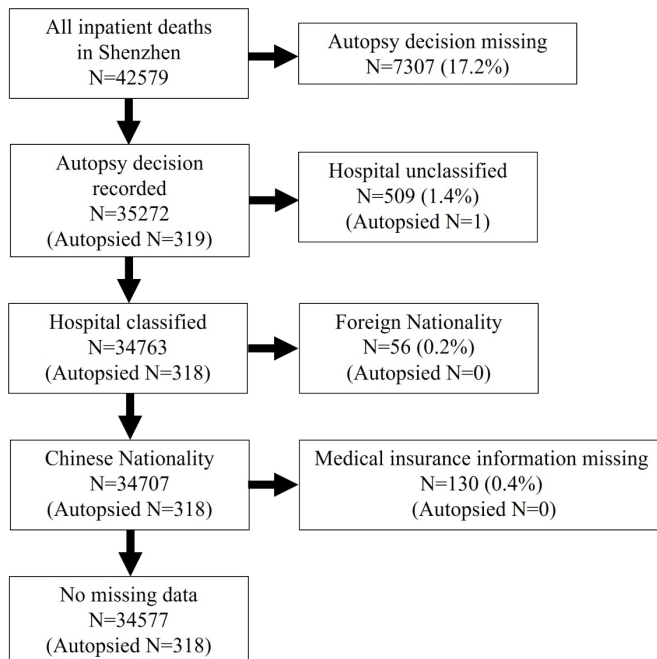


Figure 1 Flowchart of the sample size for multivariable analysis.

The level and type of hospitals were identified using information from the official website of the Public Hygiene and Health Commission of Shenzhen Municipality.²⁵ In total, there are 151 hospitals in Shenzhen, among which 18 hospitals are relatively new hospitals and have not been classified into any tier by the Health Commission of Shenzhen Municipality. Tertiary A hospitals focus on delivering specialist care for rare or complicated diseases. There are nine National Standardised Residency Training (SRT) Bases in Shenzhen, all of which are tertiary A hospitals and are academic centres. Therefore, the tertiary A hospital category was further divided into ‘national SRT base’ and ‘not national SRT base’.

Category	ICD-10 codes
Infectious and parasitic diseases	A00-B99
Neoplasms	C00-D48
Cardiovascular diseases	I00-I99
Respiratory diseases	J00-J99
Digestive diseases	K00-K93
Pregnancy, childbirth and maternity	O00-O99
Perinatal diseases and congenital disorders	P00-Q99
Other diseases	D50-H95, L00-N99
Non-disease diagnoses	R00-Z99

ICD-10, International Classification of Diseases, 10th Revision.

Statistical analysis

Descriptive statistics was used to determine the autopsy rates in Shenzhen as a whole and in subgroups. Results were presented using frequencies and percentages for categorical variables and means (SD) for continuous variables. Autopsy rates were calculated for each subgroup. As the autopsy rate met the criteria for a ‘rare event’ (binary dependent variables with dozens to thousands of times fewer events than non-events), the coefficients and standard errors of logistic regression should be corrected.²⁶ Therefore, we used rare events logistic regression. Univariable analyses were performed, followed by multivariable rare events logistic regression that included demographic factors, clinical factors and hospital factors. Poisson pseudo maximum likelihood (PPML) regression could also be used under this circumstance.²⁷ Therefore, we used PPML to check the robustness of the results. Heteroscedasticity robust standard errors were clustered at the level of the hospital for both models. All the statistical analyses were performed using Stata software (V.SE.17.0). OR and 95% CIs were reported for the strength of the autopsy associated with independent variables in the rare events logistic regression, while the coefficient and SE were reported for the PPML regression. P values less than 0.05 were considered statistically significant.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

RESULTS

From January 2016 to December 2022, a total of 42 579 inpatient deaths occurred at 104 hospitals in Shenzhen, and information on autopsy status was available for 35 272 (82.8%) decedents. Of those whose autopsy status was known, 319 had undergone an autopsy, resulting in an autopsy rate of 0.9% (319/35 272). The annual number of autopsies was 39 in 2016, 30 in 2017, 40 in 2018, 55 in 2019, 45 in 2020, 52 in 2021 and 58 in 2022. The autopsy rate for each year is presented in [figure 2](#), with a maximum of 1.13% in 2016 and a minimum of 0.76% in 2017. The missing data on autopsy status occurred primarily in 2016 (32.4%) and 2017 (26.9%) and decreased steadily to 2022 (3.5%), also shown in [figure 2](#).

The age was 46.7 (24.4) in the autopsied group and 63.7 (20.9) in the unautopsied group. Details on autopsy rates in different subgroups are summarised in [table 2](#). All the variables, except for gender, were statistically significant in univariable analyses.

[Table 3](#) presents the multivariable regression results of potential factors related to autopsy decisions. In the rare events logistic regression model, the autopsy decision was significantly and positively associated with being married (OR=1.60, 95% CI: 1.16 to 2.21), self-paying (OR=1.56, 95% CI: 1.07 to 2.26), death due to external causes of injury and poisoning (OR=1.69, 95% CI: 1.02 to 2.81)

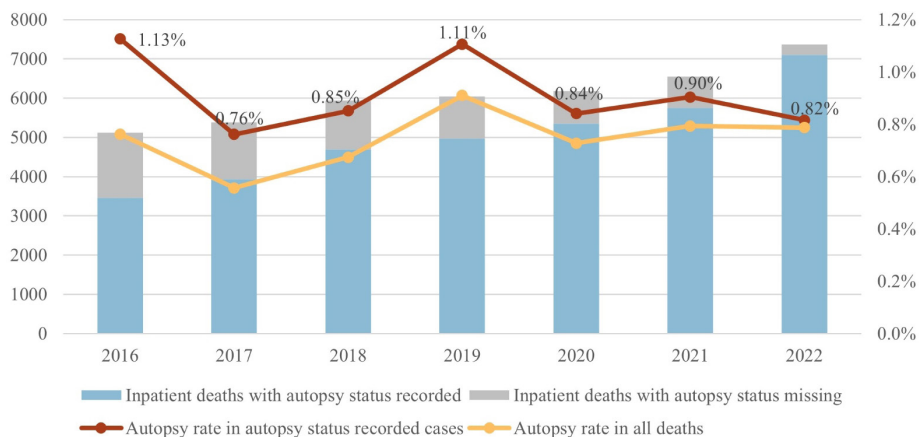


Figure 2 Year-by-year data of inpatient deaths with autopsy status known and unknown, and autopsy rates from 2016 to 2022.

and pregnancy (OR=13.58, 95% CI: 4.94 to 37.36), but negatively associated with age (OR=0.97, 95% CI: 0.96 to 0.98), emergency admission (OR=0.66, 95% CI: 0.49 to 0.88), referral (OR=0.47, 95% CI: 0.25 to 0.88), neoplasms (OR=0.35, 95% CI: 0.22 to 0.56), respiratory diseases (OR=0.49, 95% CI: 0.26 to 0.95) and for-profit hospitals (OR=0.45, 95% CI: 0.23 to 0.91). There were no statistically significant differences in autopsy rates between large teaching hospitals and other hospitals. The PPML regression yielded similar results (table 3), indicating that our findings were robust.

DISCUSSION

In this population-based retrospective observational study, we used data from the Shenzhen Health Development Research and Data Management Centre for the years 2016–2022 to investigate the autopsy rate and associated factors in the third megacity of China. To our knowledge, this study presents for the first time the prevalence and characteristics of regional inpatient autopsy in China. Three major findings were revealed in this retrospective study. First, the autopsy rate of hospital deaths was extremely low (0.9%). Second, some demographic and clinical characteristics, including age, marital status, type of medical insurance, hospital admission pathway, death due to external causes of injury and poisoning and certain diagnoses, were associated with the decision of autopsy. Third, the large teaching hospitals do not request more autopsies compared with primary or secondary hospitals after controlling for the patients' characteristics.

The overall inpatient autopsy rate in Shenzhen is lower than that of many developed countries. In the USA, for example, the autopsy rate of hospital deaths was 3.1% in 2020.²⁰ Higher rates were reported in the UK with 10.1% in 2019 and 6.9% in Nordic countries.²⁸ Despite the COVID-19 pandemic, the inpatient autopsy rate in Shenzhen did not change much in the 7 years observed. Each year, fewer than 60 autopsies were performed in hospital deaths in this megacity. With such a low number of inpatient autopsies, it is difficult to learn from the dead for

clinical, education, research and public health purposes. The vanishing inpatient autopsy contributes to a reduction in pathology expertise in clinical autopsy and on-site autopsy facilities, which further hinders the request for autopsies and perpetuates a vicious cycle. Many hospitals in Shenzhen do not have on-site autopsy capabilities, and medicolegal autopsies are sent to regional autopsy centres.

Some demographic characteristics are significantly related to autopsy decision. In accordance with other research, autopsy rates decline with the age of decedents.^{20 29 30} The death of a child or young adult is often considered unnatural, and the investigation of death in babies may benefit the counselling parents on future pregnancies.³¹ There is also a higher rate of autopsy in married decedents. In mainland China, marriage is found to be associated with lower mortality rates and better health.³² In non-criminal cases, the consent of the deceased's close relatives is the prerequisite for an autopsy. The spouse is typically the most important person to make the autopsy decision. The primary reason the family members consent to an autopsy is to find out the cause of death.³³ The spouse may have more motivation to ask for an autopsy, either for spiritual comfort by understanding the exact cause of death or for the need for evidence that could be crucial in potential medical litigation. The cost of an autopsy is regarded as a barrier.²² However, our study found that self-paying patients were more likely to undergo an autopsy. One possible explanation is that the autopsy of self-paying decedents is more for litigation purpose, so that the autopsy will result in considerable compensation to alleviate financial burdens on their families.

Clinical characteristics also influence the likelihood of undergoing an autopsy. Deaths due to external causes of injury and poisoning, which accounted for 25% (78/318) of the total number of autopsies, were more likely to have an autopsy. In cases of death resulting from external causes such as violent injuries, car accidents or suspicious poisoning, the incident is likely to be treated as a

Table 2 Number of deaths, percentages autopsied in subgroups and p values of univariable rare events logistic regressions of autopsy decision: Shenzhen, 2016–2022

	Total	Autopsied	Not autopsied	Autopsy rate (%)	P value
Gender					
Male	21 618	207	21 411	0.96	Ref
Female	12 959	111	12 848	0.86	0.350
Ethnicity					
Han	34 017	305	33 712	0.90	Ref
Other	560	13	547	2.32	<0.001
Marital status					
Married	26 810	220	26 590	0.82	<0.001
Other	7767	98	7669	1.26	Ref
Medical insurance					
UEBMI	13 915	86	13 829	0.62	Ref
URBMI	5660	31	5629	0.55	0.596
All self-paying	10 727	161	10 566	1.50	<0.001
Other	4275	40	4235	0.94	0.027
Hospital admission pathway					
Outpatient	15 743	112	15 631	0.71	Ref
Emergency	17 538	185	17 353	1.05	0.001
Transferred from other medical institutions	741	12	729	1.62	0.005
Other	555	9	546	1.62	0.011
Length of stay					
1 day	5361	87	5274	1.62	<0.001
2–6 days	7676	77	7599	1.00	0.014
≥7 days	21 540	154	21 386	0.71	Ref
External causes of injury and poisoning					
Yes	2508	78	2430	3.11	<0.001
No	32 069	240	31 829	0.75	Ref
Department					
Internal medicine	11 497	79	11 418	0.69	<0.001
Surgery	6455	108	6347	1.67	0.343
Other	16 625	131	16 494	0.79	Ref
Main clinical diagnosis					
Infectious and parasitic diseases	2634	32	2602	1.21	0.591
Neoplasms	12 827	46	12 781	0.36	<0.001
Cardiovascular diseases	7653	85	7568	1.11	0.822
Respiratory diseases	4657	14	4643	0.30	<0.001
Digestive diseases	1755	18	1737	1.03	1.000
Pregnancy, childbirth and maternity	32	6	26	18.75	<0.001
Perinatal diseases and congenital disorders	529	21	508	3.97	<0.001
Other diseases	1755	18	1737	1.03	Ref
Non-disease diagnoses	2735	78	2657	2.85	<0.001
Hospital level					
Tertiary A and national SRT base	17 522	190	17 332	1.08	Ref
Tertiary A, not national SRT base	8545	68	8477	0.80	0.030
Tertiary	4908	36	4872	0.73	0.036

Continued



Table 2 Continued

	Total	Autopsied	Not autopsied	Autopsy rate (%)	P value
Secondary	1118	15	1103	1.34	0.363
Primary	2484	9	2475	0.36	0.002
Hospital type					
Not-for-profit	31 294	308	30 986	0.98	Ref
For-profit	3283	10	3273	0.30	<0.001

UEBMI, which is mandatory for workers in urban areas, with premiums paid by both employers and employee. Residents not covered by UEBMI can join the voluntary URBMI, jointly financed by premiums and government.⁴⁹
SRT, standardised residency training; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance.

potential criminal case. The national security authority will determine whether an autopsy is necessary based on the circumstances. The family cannot prevent the autopsy if it is deemed essential for the investigation. In contrast, neoplasm diagnoses were associated with a lower likelihood of autopsy since the cause of death is supposedly known.³⁴ In China, maternal mortality is closely monitored and investigated more thoroughly. Hospitals are required to report the case to the designated health-care institutions within 2 hours of a maternal death, and subsequent detailed information of the death case is also required for the national online reporting information system, which prompts an autopsy request.³⁵ Though in univariable analyses, shorter hospital stays before death, emergency admission and referral were associated with higher autopsy rates, they were not significantly or even negatively associated with autopsy when controlling for other covariates, suggesting that there is no additional interest in exploring the cause of death in unexpected, severe or urgent cases.

In addition to patient-related characteristics, institutional factors may also influence an individual's likelihood of autopsy uptake. There is a large variation in the autopsy rates among hospitals in the USA, and larger hospitals and teaching hospitals were associated with higher autopsy rates.^{18 36 37} However, after controlling for patient-related characteristics, there was no longer a statistically significant difference between the best Tertiary A hospitals and other hospitals in Shenzhen. The patients in secondary and primary hospitals often have common and mild diseases. The unexpected death in secondary and primary hospitals may be more related to malpractice, which could lead to a request of autopsy. In fact, several best Tertiary A hospitals in Shenzhen have the necessary facilities and qualified pathologists to perform autopsies. It is a pity that the best Tertiary A hospitals in Shenzhen do not show greater enthusiasm for performing autopsies to improve the quality of diagnosis and treatment than secondary and primary hospitals. The for-profit hospitals were associated with lower autopsy rate, as in China they primarily provide medical services not commonly provided by public hospitals such as rehabilitation and hospice care.³⁸

It is imperative and urgent for China to emphasise the importance of autopsy and increase the autopsy rate. In some countries, clinical autopsy is not routinely performed due to perceived religious and cultural resistance.^{39 40} However, the autopsy rate reached more than 50% in some Chinese teaching hospitals in the 1950s, and the high autopsy rate was mainly attributed to the efforts the hospitals and government made to educate the public and promote autopsies.⁷ Our study also indicates that family members would accept autopsy if it is deemed beneficial. There are insufficient initiatives among clinicians to facilitate autopsies. The litigation concern was prominent among healthcare workers towards autopsy.^{41 42} The physician–patient relations have been quite tense in China in recent years.⁴³ Physicians' distrust of patients and their families leads to fear and self-protections, which hinders transparent communications and medical error disclosure.⁴⁴ The extremely low autopsy rate in China is more due to healthcare providers' side. More efforts are urged to encourage hospitals and healthcare providers to proactively request autopsies, helping to revive this important procedure.

Multi-faceted actions must be launched to increase the autopsy rate in China urgently. At the country level, the number of clinical and legal autopsies should be included in China's national health statistics as routine indicators to reflect the true state of autopsies. Acknowledging the reality of the extremely low clinical autopsy rate is the first step toward improvement. At the regional level, in addition to making better use of existing regional autopsy centres to facilitate clinical autopsies in non-academic hospitals, local health authorities should monitor the number of each type of autopsy, provide financial support for clinical autopsies and offer feedback to hospitals. At the hospital level, an institutional Office of Decedent Affairs may function as a direct communication link between pathology and decedents' families, providing autopsy-related discussions and bereavement counselling.⁴⁵ The value of clinical autopsies on medical advancement and quality control should be emphasised to all health professionals, from undergraduate education to continuing education. Residents should be trained on structured conversations with relatives regarding autopsies, and cooperation should be

Table 3 The multivariable rare events logistic regression and Poisson pseudo maximum likelihood model results of autopsy decision and potential associated factors

	Rare events logistic model			Poisson pseudo maximum likelihood model		
	OR	95%CI	P value	Coefficient	SE	P value
Gender						
Male (ref)						
Female	1.02	(0.80, 1.30)	0.892	0.012	0.122	0.919
Age	0.97	(0.96, 0.98)	<0.001	-0.031	0.004	<0.001
Ethnicity						
Han (ref)						
Other	1.64	(0.79, 3.39)	0.184	0.441	0.349	0.208
Marital status						
Married	1.60	(1.16, 2.21)	0.004	0.471	0.160	0.003
Other (ref)						
Medical insurance						
UEBMI (ref)						
URBMI	1.06	(0.56, 1.98)	0.866	0.041	0.315	0.895
All self-paying	1.56	(1.07, 2.26)	0.021	0.436	0.187	0.020
Other	1.43	(0.82, 2.49)	0.209	0.341	0.277	0.218
Hospital admission pathway						
Outpatient (ref)						
Emergency	0.66	(0.49, 0.88)	0.004	-0.408	0.142	0.004
Transferred from other medical institutions	0.47	(0.25, 0.88)	0.018	-0.766	0.307	0.012
Other	0.74	(0.34, 1.61)	0.447	-0.338	0.383	0.377
Length of stay						
1 day	1.19	(0.89, 1.60)	0.234	0.170	0.143	0.235
2–6 days	1.00	(0.79, 1.26)	0.994	-0.002	0.116	0.989
≥7 days (ref)						
External causes of injury and poisoning						
Yes	1.69	(1.02, 2.81)	0.041	0.508	0.251	0.043
No (ref)						
Department						
Internal medicine (ref)						
Surgery	1.37	(0.89, 2.12)	0.156	0.310	0.218	0.155
Other	0.64	(0.46, 0.89)	0.009	-0.440	0.169	0.009
Main clinical diagnosis						
Infectious and parasitic diseases	1.43	(0.90, 2.28)	0.126	0.365	0.230	0.113
Neoplasms	0.35	(0.22, 0.56)	<0.001	-1.019	0.238	<0.001
Cardiovascular diseases	1.25	(0.79, 1.98)	0.340	0.241	0.230	0.295
Respiratory diseases	0.49	(0.26, 0.95)	0.034	-0.711	0.329	0.031
Digestive diseases	1.14	(0.65, 2.00)	0.646	0.129	0.281	0.646
Pregnancy, childbirth and maternity	13.58	(4.94, 37.36)	<0.001	2.383	0.428	<0.001
Perinatal diseases and congenital disorders	1.29	(0.57, 2.94)	0.541	0.262	0.405	0.518
Other diseases (ref)						
Non-disease diagnoses	1.36	(0.88, 2.10)	0.161	0.321	0.217	0.138
Hospital level						
Tertiary A and national SRT base (ref)						
Tertiary A, not national SRT base	0.59	(0.34, 1.04)	0.070	-0.514	0.282	0.069
Tertiary	0.65	(0.36, 1.16)	0.143	-0.437	0.288	0.130

Continued



Table 3 Continued

	Rare events logistic model			Poisson pseudo maximum likelihood model		
	OR	95%CI	P value	Coefficient	SE	P value
Secondary	1.01	(0.50, 2.06)	0.973	-0.021	0.348	0.951
Primary	0.95	(0.45, 1.97)	0.884	-0.107	0.361	0.766
Hospital type						
Not-for-profit (ref)						
For-profit	0.45	(0.23, 0.91)	0.026	-0.812	0.343	0.018

Heteroscedasticity robust SEs are clustered at the level of hospital (92 hospitals) for both models.
SRT, standardised residency training; UEBMI, Urban Employee Basic Medical Insurance; URBMI, Urban Resident Basic Medical Insurance.

more intensified between clinicians and pathologists.⁴⁶ Last but not least, a patient safety culture should be fostered to alleviate concerns about the potential punishment for errors found by autopsies, as a blame culture is still pervasive in the Chinese health system.^{47 48}

Limitations

There are some limitations of this study. First, the autopsy status was missing in about 17.2% of cases, which may cause some biases in our analysis. The missing data of autopsy status occurred primarily in the first 2 years, and then decreased steadily throughout the remaining years (3.5% in the last year). The overall rate of missing autopsy status is comparable to a previous study in the USA, in which a 13.4% missing rate was reported.²⁶ Second, we were unable to collect the information on the motivation for each autopsy. The autopsy studied in our research included those performed at the request of clinicians for clinical concerns or at the request of family members for medicolegal purposes, as well as forensic autopsies aimed at investigating homicidal or other violent deaths. Considering the number of cases with external causes of injury and poisoning, the actual rate of clinical autopsy is even lower. Third, the variables such as educational background and occupation of the deceased individuals were not analysed. More than 50% of these two potential covariates were missing. Therefore, these two variables were not included in the regression models. Lastly, we only analysed inpatient autopsy in Shenzhen. As a leading technology hub, Shenzhen has been at the forefront of healthcare data collection in China. The variation in autopsy rates among different geographical regions within one country could be very large, and cities with more population may have higher autopsy rates.²⁵ Our descriptive and univariable results also showed that the autopsy rate of some lower-tier hospitals is lower than academic centres. There are 18 000 county hospitals and 34 000 township health centres in rural China, none of which exist in Shenzhen city. However, our results are consistent with the autopsy rate in leading teaching hospitals nationwide, implicating a good representation of major Chinese cities. The management of healthcare data in other parts of China needs to be improved, and

national data regarding autopsy rates and types should be collected and summarised the sooner the better.

Conclusion

The autopsy rate of hospital deaths in this Chinese megacity was extremely low. Some demographic and clinical characteristics, including age, marital status, type of medical insurance, hospital admission pathway, death due to external causes of injury and poisoning and certain diagnoses, were associated with the decision to autopsy. The large teaching hospitals do not request more autopsies compared with other hospitals, after controlling for patient characteristics. The national data regarding autopsy rates and types should be collected and summarised. More efforts are urged to encourage hospitals and healthcare providers to proactively request autopsies, helping to revive this important procedure.

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Patient consent for publication Not applicable.

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