

CLINICAL AUTOPSY AS AN OUTCOME MEASURE AND TOOL FOR QUALITY IMPROVEMENT AT THE CAPE COAST TEACHING HOSPITAL

Akakpo KP¹; Derkyi-Kwarteng L¹; Imbeah EG¹; Ulzen-Appiah K¹; Ansong SYO²; Eliason S²; Awuku YA³

¹Department of Pathology; ²Department of Community Medicine, ³Department of Internal Medicine and Therapeutics, School of Medical Sciences, University of Cape Coast, Cape Coast Teaching Hospital, Cape Coast, Ghana

Abstract

Objective: We set out to investigate, the relationship between the antemortem clinical diagnosis and the clinical autopsy diagnosis, as a tool to assess the quality of health care in our institution.

Methodology: A retrospective review of clinical records of hospital autopsies done in the Cape Coast Teaching Hospital from 1st January 2011 to 31st December 2014 was conducted. An analysis of the ante mortem diagnosis and the autopsy diagnosis was conducted by the Departments of Internal Medicine and Therapeutics, Community Medicine, and Pathology of the School of Medical Sciences, Cape Coast Teaching Hospital. Discrepancies were identified and classified according to the Goldman criteria as major missed diagnosis and minor missed diagnosis.

Results: Fifty hospital autopsy cases were reviewed. There was no error in 20(40 %) of the cases. Of the 30

cases (60%) had discrepancies and were classified using the Goldman criteria, 12 out of the 30 (40%) were major class I type errors, 15(50 %) were major class II type errors and the remaining 3(10%) were minor class IV type errors. The diseases were categorized into: others (causes of death that could not be categorized under either infections, cancers, cardiovascular disease, pregnancy related and metabolic) 15 (30%), infections 14 (28%) and cancers 10 (20%) were commonly autopsied, and most were from the medical ward.

Conclusion: Significant discrepancies between the antemortem clinical diagnosis and the autopsy diagnosis at the Cape-Coast Teaching Hospital were identified. No statistically significant relationship was found between clinical departments and ACD/AD discrepancy or between category of disease and ACD/AD discrepancy.

Key Words: audit, antemortem, post-mortem, diagnosis, Cape Coast, Ghana

Introduction

With the current emphasis on evidence-based medicine and quality in health care, autopsy diagnoses can help evaluate the medical treatments or interventions that a patient receives, and whether or not those interventions are appropriate.¹ Clinical autopsies are carried out with permission from relations of patients who die in the care of clinicians. They are done to investigate only natural deaths (solely due to disease). In low resource settings, such as the Cape Coast Teaching Hospital some important diagnostic methods are not readily available, or where available may not be affordable. Audits of autopsies carried on clinical cases are a cheap and reliable way of ensuring quality in clinical care. Clinical autopsy rates have however plummeted worldwide^{2,13,14}, and Ghana is no exception¹⁵. The cause of this decline in Ghana are many and include; religious and traditional beliefs, financial considerations, physicians fear of litigation, lack of interest in autopsies among both pathologists

and other clinicians, and the unavailability of trained pathologists to serve the many hospitals.² This is despite the demonstration in literature of a high prevalence of errors in antemortem clinical diagnosis discovered at autopsy and multiple studies suggesting no significant decrease in these errors over time.³

Shojania et al of University of California at San Francisco-Stanford in their systematic audit of articles comparing autopsy diagnosis (AD) and antemortem clinical diagnosis (ACD) titled 'The Autopsy as an Outcome and Performance Measure' concluded that at the level of the individual clinician, the chance that an autopsy will reveal important unsuspected diagnosis in a given case remains significant¹¹. They also reported that clinicians do not seem to be able to predict the cases in which such findings are likely to occur¹¹. Finally, they reported that existing literature thus demonstrate that ACD, whether obtained from death certificates or hospital discharge data, contain major inaccuracies compared with AD and thus the healthcare system as a whole can benefit enormously from autopsy data, by substantially enhancing the accuracy of vital statistics, which play important roles in research, funding, and other policy decisions.¹¹

However, in an editorial on Shojania et al's article by Bove K.E, Bove notes that the authors in their analysis of 42 previous studies on autopsy discrepancy report that indeed decreases in errors have occurred during

Corresponding Author: Dr. Kofi Ulzen-Appiah

Department of Pathology University of Cape Coast,
Cape Coast, Ghana

Tel: +233(0) 248271935,

Email Address: kulzenap@gmail.com

Conflict of Interest: None Declared

the 40-year time span within which the studies were carried out. This notwithstanding previous reports based on individual studies to the contrary. This is against the background of the competing effect of clinical selection of more difficult cases for autopsy, as autopsy rates have decreased.⁴ This study includes only studies that reported major errors, were deemed most likely to have affected patient outcomes. Bove notes that clinicians participated in these judgments in about two thirds of the studies, he mentions that this is a critically important feature for any effort to place autopsy-based diagnoses in realistic clinical context.⁴ It has been reported in some studies that discrepancy rates vary for various departments with higher discrepancy rates reported for intensive care patients and for surgical patients. These studies also report a decrease in discrepancy rates with an increase in clinical autopsy rates.⁴ In a study that focused on patients who die in the intensive care unit, Perkins et al conclude that postmortem examinations remain a useful tool in confirming diagnostic accuracy and should be considered in all patients who die in the intensive care unit. Although they were limited by the number of cases studied (38 cases) they conclude that they did not find an association between the length of ICU stay and the number discrepancies found at autopsy⁷.

Benefits derived from the autopsy which can be of immense value in the attainment of health goals in a poor resource setting largely relate to the role of the autopsy in detecting discrepancies in clinical diagnosis and in revealing unsuspected complications of treatment. Other benefits include detection of new patterns in old diseases, revealing disease course and cause of death to next of kin of a deceased patients, aiding the investigation of environmental, occupational, and lifestyle-related diseases and also providing tissue for research.⁷ The autopsy can thus serve as a clinical performance measure and also serve as an instrument for quality improvement. This study aims at studying the current discrepancy rates between AD and ACD at the Cape Coast Teaching Hospital.

Methodology

A retrospective review of the clinical records of patients who died and were autopsied in the Cape Coast Teaching Hospital between 1st January 2011 and 31st December 2014 was done. A total of 774 autopsies were conducted in this period. Seventy-eight (78) (10%) of the cases were classified as clinical autopsies. Six hundred and ninety-six (696) (90%) cases were medicolegal cases referred to our hospital's autopsy suite from various Coronial districts after dying in the communities. The causes of these 696 deaths were mostly unnatural (accidents, suicides and homicides). These medicolegal autopsies were excluded from the study. The ACD was compared to the AD. Only

clinical autopsies were included in the study. Cases autopsied but without available clinical records were excluded from the study. The data was reviewed by 2 pathologists and the discrepancies classified according to the Goldman criteria (**TABLE 1**). Detailed analysis of cases in relation to departments, disease category and their various relationships was done. Tests of significance were calculated. Secondary data from selected patient records and their respective autopsy data were used in the study. All medico-legal cases and cases with missing records were excluded from the study. A descriptive analysis of the data was done according to the Goldman criteria for clinical autopsy discrepancies.

Table 1- Goldman criteria for autopsy discrepancies

CLASS	DESCRIPTION
CLASS I	Missed major diagnosis with a potential adverse impact on survival that would have changed management
CLASS II	Missed major diagnosis with no potential impact on survival that would not have changed therapy
CLASS III	Missed minor diagnosis related to terminal disease but not related to the cause of death
CLASS IV	Other missed minor diagnosis
CLASS V	Absolute autopsy agreement between antemortem and autopsy diagnosis
CLASS VI	Uncertain autopsy diagnosis

Results

A total of 774 autopsies were conducted from January 2011 to December 2014. Seventy-eight (78) (10%) of the cases in this period were classified as clinical autopsies. Out of the 78 clinical cases, 28 were excluded due to unavailable or incomplete clinical records leaving 50 cases, that were used in the study. Out of the 50 cases studied, 20(40%) were males and 30(60%) females (**TABLE 2**). Majority of the cases (18) comprising thirty six percent of the deaths were recorded in the department of medicine. This was followed in decreasing order by the department of surgery 8(16%), Intensive Care Unit 7(ICU) 14%, and Pediatrics 3(6%). The departments of Obstetrics and Gynecology (O&G) and the Accidents and Emergency (A&E) had 8(16%) and 6(12%) respectively, (**TABLE 2**). Regarding discrepancies between AD and ACD, the results showed no discrepancy in 20(40) % of the cases. Of the 30 cases (60%) that had discrepancies, 12(40%) had a postmortem diagnosis, that if recognized would have altered the therapy or survival

(Major class I type errors), 15(50 %) had a postmortem diagnosis, that if recognized would not have altered therapy or survival though major (Major class 2 type errors) and 3(10%) had a postmortem diagnosis, that was not related to the primary disease that caused death but may have altered survival (minor class IV type errors). The diagnoses were categorized into infections, cardiovascular diseases, metabolic disease, cancers, pregnancy related and others (Others are the diseases (cause of death) that cannot be grouped under the other categories based on the aetiology of the disease that is;infections, cancers, cardiovascular disease, pregnancy related and metabolic). Majority of the cases belonged to the category of others 15(30%) followed by infections 14(28%), and then cancers 10(20%). The metabolic diseases category had the least number of autopsies requested on them 1(2%) (TABLE 2).

Table 2- Frequency distribution of the cases analyzed

		Frequency	Percent (%)
Gender	Male	20	40.0
	Female	30	60.0
	Total	50	100.0
Unit	A&E	6	12.0
	Medical	18	36.0
	Surgical	8	16.0
	ICU	7	14.0
	Pedics	3	6.0
	O&G	8	16.0
	Total	50	100.0
Goldman's Classification	Major class 1	12	24.0
	Major class 2	15	30.0
	Minor 4	3	6.0
	No error	20	40.0
	Total	50	100.0
Category of diseases	Infection	14	28.0
	Cardiovascular	4	8.0
	Metabolic	1	2.0
	Cancers/ tumor	10	20.0
	Others	15	30.0
	Pregnancy related	6	12.0
	Total	50	100.0

Table 3: Unit Group * Goldman Classification System Crosstabulation

System			Goldman Classification				Total
			Major class 1	Major class 2	Minor 4	No error	
Infection	Unit Group	A&E	0 (0.0%)	0 (0.0%)		1 (100.0%)	1 (100.0%)
		Medical	2 (25.0%)	3 (37.5%)		3 (37.5%)	8 (100.0%)
		Surgical	0 (0.0%)	0 (0.0%)		2 (100.0%)	2 (100.0%)

		ICU	1 (50.0%)	0 (0.0%)		1 (50.0%)	2 (100.0%)
		Pedics	0 (0.0%)	1 (100.0%)		0 (0.0%)	1 (100.0%)
		Total	3 (21.4%)	4 (28.6%)		7 (50.0%)	14 (100.0%)
Cardiovascular	Unit Group	Medical		2 (100.0%)		0 (0.0%)	2 (100.0%)
		ICU		1 (100.0%)		0 (0.0%)	1 (100.0%)
		O&G		0 (0.0%)		1 (100.0%)	1 (100.0%)
	Total		3 (75.0%)		1 (25.0%)	4 (100.0%)	
Metabolic	Unit Group	A&E				1 (100.0%)	1 (100.0%)
	Total					1 (100.0%)	1 (100.0%)
Cancers/Tumor	Unit Group	A&E	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	1 (100.0%)
		Medical	2 (50.0%)	1 (25.0%)	1 (25.0%)	0 (0.0%)	4 (100.0%)
		Surgical	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)
		ICU	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
		Pedics	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1 (100.0%)
		O&G	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
	Total		3 (30.0%)	4 (40.0%)	2 (20.0%)	1 (10.0%)	10 (100.0%)
Others	Unit Group	A&E	1 (33.3%)	1 (33.3%)	0 (0.0%)	1 (33.3%)	3 (100.0%)
		Medical	1 (25.0%)	1 (25.0%)	1 (25.0%)	1 (25.0%)	4 (100.0%)
		Surgical	1 (25.0%)	1 (25.0%)	0 (0.0%)	2 (50.0%)	4 (100.0%)
		ICU	1 (33.3%)	0 (0.0%)	0 (0.0%)	2 (66.7%)	3 (100.0%)
		Pedics	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	1 (100.0%)
		Total		4 (26.7%)	3 (20.0%)	1 (6.7%)	7 (46.7%)
	Pregnancy related	Unit Group	O&G	2 (33.3%)	1 (16.7%)		3 (50.0%)
Total			2 (33.3%)	1 (16.7%)		3 (50.0%)	6 (100.0%)
Total	Unit Group	A&E	1 (16.7%)	1 (16.7%)	1 (16.7%)	3 (50.0%)	6 (100.0%)
		Medical	5 (27.8%)	7 (38.9%)	2 (11.1%)	4 (22.2%)	18 (100.0%)
		Surgical	2 (25.0%)	2 (25.0%)	0 (0.0%)	4 (50.0%)	8 (100.0%)
		ICU	2 (28.6%)	2 (28.6%)	0 (0.0%)	3 (42.9%)	7 (100.0%)
		Pedics	0 (0.0%)	1 (33.3%)	0 (0.0%)	2 (66.7%)	3 (100.0%)

	O&G	2 (25.0%)	2 (25.0%)	0 (0.0%)	4 (50.0%)	8 (100.0%)
Total		12 (24.0%)	15 (30.0%)	3 (6.0%)	20 (40.0%)	50 (100.0%)

Further analysis of the contribution of each department to the Goldman's error category showed that the leading department (internal medicine) contributed 41.7% of major class I errors, 46.7% of major class II errors, 66.7% of minor class IV errors and 20% to the no errors. (**TABLE 3**). When the major class I errors were further analyzed, it was found that majority of them belonged to the disease category of others (33.3%), followed by infections and cancers (25% each) and then by pregnancy related diseases (16.7%). When further analyzed, it was realized that, although most of the cases from the department of internal medicine were infections (44.4%), the department contributed only two (2) of these to the major class I error category with the other six (6) split equally (3) between major class II errors and the no error category. No statistically significant relationship was found between departments and category of diseases and Goldman's error categories. (**TABLE 3**)

Discussion

The value of autopsy in clinical audit has been highlighted in studies, and it has been suggested that auditing discrepancies between autopsy findings and clinical diagnosis may be used to improve diagnostic accuracy.² By analyzing discrepancy rates between AD and ACD, a reliable database can be developed to support mortality audits. Our study showed that there was complete agreement between the ACD and AD in 40 % of the cases; a clinical autopsy was however requested. This is in line with the use of clinical autopsies to confirm clinical suspicions, study the state of individual organ systems and study the extent of a known diagnosed condition. These kinds of request provide additional scientific material for publications and for medical education.

As stated in a review by Bove KE, an essential use of the clinical autopsy in this era of declining rates is the educational benefit to the clinician, such as the ability to assess the severity or extent of a disease correctly identified or strongly suspected antemortem.² In the same review, other benefits observed include, the opportunity to evaluate the efficacy of therapies, unrestricted access to tissue samples for additional diagnostic testing, and finally, the opportunity to extend understanding of pathologic processes by collecting and studying samples from many patients with the same disease at different stages in the

diseases' natural history. The above benefits remain important justifications for conducting clinical autopsies.² Though our ACD/ AD concordance figure of 40% is lower than the 62% quoted in other studies, the lower concordance between the ACD and AD in our setting may be attributable to the lack of some diagnostic methods in the Cape Coast Teaching Hospital or the inability of some patients to afford these tests when they are even available. It may also be the case that clinicians do not request autopsies for the above stated reasons once they are certain of the ACD. Instead, clinicians may prefer to request autopsies when they are not certain about the ACD. By selecting cases considered more difficult in the clinical setting, the concordance between the ACD and the AD is likely to decrease.

On the other hand, if cases are selected randomly without regard to clinical difficulty, this is likely to improve concordance between ACD and AD. Out of the 30 (60%) cases that had discrepancies, 40% had postmortem diagnosis that if recognized earlier by clinicians, would have altered therapy or survival (Major class 1 type errors). A few examples of the Major class 1 type errors identified include; an AD of pyogenic meningitis (infection) and ACD of severe pre-eclampsia/eclampsia (pregnancy related), AD of perforated appendix (others) and ACD of peptic ulcer disease (others), an AD of tuberculous bronchopneumonia (infections) and ACD of community acquired pneumonia (infections). 50 % had postmortem diagnoses, that if recognized would not have altered therapy or survival (Major class II errors).

Selected examples include an AD of hepatocellular carcinoma (cancers) and ACD of alcoholic liver disease (others), an AD of progressive massive fibrosis of the lung (others) and ACD of lung cancer (cancers). Ten percent (10%) had minor postmortem diagnosis that were not related to the primary disease that caused death (minor class IV type errors). This falls within the general median error range of 4.1%-49.8% in Kaveh et al¹⁰ study. In that study, it was concluded that the possibility that a given autopsy will reveal important unsuspected diagnoses has decreased over time, but remains sufficiently high that encouraging ongoing use of the autopsy as an audit tool appears to still be warranted.¹⁰ By analyzing the results of 53 distinct autopsy series over a 40-year period, Kaveh et al showed statistically significant decreases over time for major errors detected at autopsy.¹⁰ In our case, no such previous studies have been carried out and thus are unable to compare and comment on the trends over time, however further studies in this area will be

encouraged using larger populations to add on to literature.. Findings of unchanged discrepancy rates between ACD and AD are most pronounced in studies on critically ill patients who die in intensive care units. In this regard our study is limited by the number of ICU patients studied (7), though further analysis showed that ICU cases accounted for 16.7% of major class I discrepancies, 13.3% of major class II discrepancies and 15.0% of minor class IV discrepancy. When tests for statistical significance was carried out, no statistically significant relationship was found between cases from the ICU and Goldman's discrepancy categories. When this was done for other departments, there was still no statistically significant relationship between departments and the Goldman categories. Neither was there a statistically significant relationship between the category of disease and the Goldman criteria. Postmortem histology has been reported by some studies to further increase discrepancy rates. Some of these studies conclude that; despite the advances in the diagnosis and treatment of critically ill patients, autopsies continue to show major discrepancies between the ACD and AD.^{5, 6, 7, 8.} These studies further conclude that considering that there is only moderate agreement between AD and ACD, autopsy remains a valuable procedure, the goal of which is not to uncover mistakes made by clinicians or to judge clinicians but rather to help instruct clinicians by providing them with the information to learn through their own mistakes.^{9,10,11}

In a study titled 'Minimizing mistakes in clinical diagnosis' Ermenc B. report that even though it is expected that progress made in medical diagnostic methods will be accompanied by a similar improvement in diagnostic accuracy, in reality the discrepancy rates has remained the same. In his view, autopsy is the best source of information on diagnostic accuracy. He suggests that an increase in the number of clinical autopsies performed and the follow-up of these autopsies could reduce the number of diagnostic mistakes.⁵ The stability in error rates has been attributable to increased selection bias towards difficult cases by clinicians.⁵ Clinical selection occurs in the Cape Coast Teaching Hospital with clinicians selecting the most confounding cases for autopsy. With progressively fewer autopsies performed in many centers over time including the Cape Coast Teaching Hospital, it is postulated that clinical selection of diagnostically challenging cases for autopsy might offset true gains in diagnostic accuracy reported at autopsy, creating the erroneous impression that there is a high rate of inaccuracies.⁴ However, it is also argued

that several prospective studies have shown clinicians to have little ability to identify cases that will yield "diagnostic surprises," so clinical selection might exert little effect on rates of autopsy detected diagnostic errors.^{5, 12} The extent to which clinical selection contributed to the rates of errors in this study cannot be quantified though it played a role in the selection of cases.

In Ghana, studies of this nature are lacking and there are no baseline studies comparing trends over a set period. Focusing on this high rate of major errors may suggest autopsy data as potential fuel for allegations of medical malpractice. However studies have demonstrated that standard-of-care issues, not diagnostic imprecision, are at the heart of most malpractice lawsuits.⁵ Bove in his study cautions that 'it must be recognized that a certain degree of diagnostic imprecision may be unavoidable, given that medical care (including postmortem evaluation of manifestations of disease) is not an exact science, that our tools are not perfect, and the time to apply them prior to death may be short'.⁴ Future research into the factors leading to errors in ACD, establishing optimal means of using autopsy data in performance improvement strategies, and exploring different mechanisms for encouraging autopsies should be encouraged in low resource settings such as the Cape Coast Teaching Hospital.³

Conclusion

There is a significant discrepancy rate between the ACD and the AD at the Cape Coast Teaching Hospital. There is however no statistically significant relationship between clinical department and ACD/AD discrepancy or between category of disease and ACD/AD discrepancy. Establishing optimal means of using autopsy as an audit tool and autopsy data in performance improvement strategies and exploring different mechanisms for encouraging autopsies must be given needed attention and focus.

Limitations

Our sample size of 50 patients is admittedly small and thus may not be an objective basis to draw conclusions statistically significant relationships. Again, considering that each department has unique patients, this may have affected the rate of discrepancy between the various departments. Again, some departments were more likely to request clinical autopsies than others. This is determined by the expertise and experience of those requesting permission for the autopsy and by cultural beliefs about

the urgency for burying the deceased. Finally, without a systematic randomized way requesting autopsies, there will always be a bias towards selecting cases based on level of difficulty and this may ultimately create the impression of high rates of discrepancy between ACD and AD.

Ethics & Consent

Ethical clearance was obtained from the University of Cape Coast Institutional Review Board through the department of Community Medicine for the project to be carried out in the 2014/15 academic year. In addition, the Cape Coast Teaching Hospital granted institutional accent for the project to be carried out in the facility. Back then, there was no ERC. Consent was not sought from relations of the deceased since the study was not about the causes of death but the ACD and AD concordance. No individuals were identified in this study.

References

1. Akakpo PK. Factors militating against autopsy practice in Ghana in Akakpo PK, editor. *A guide to Autopsy Practice in Ghana*: Icon publishing 2015, p7.
2. Bove KE. The Challenge of Using Autopsy Information for Quality Improvement. *Arch Pathol Lab Med*. 2004; 128, 11-12.
3. Dimopoulos G1, Piagnerelli M, Berré J, Salmon I, Vincent JL. Postmortem examination in the intensive care unit: still useful? *Intensive Care Med*. 2004; 30:2080-2085.
4. Ermenc B. Comparison of the clinical and postmortem diagnoses of the causes of death. *Forensic Sci Int*. 2000;13; 114 :117-119.
5. Ermenc B. Minimizing mistakes in clinical diagnosis. *J Forensic Sci*. 1999; 44 :810-813.
6. Khawaja O, Khalil M, Zmeili O, Soubani AO. Major discrepancies between clinical and postmortem diagnoses in critically ill cancer patients: Is autopsy still useful? *Avicenna J.Med*. 2013; 3:63-67. doi:10.4103/2231-0770.118460.
7. Perkins GD, McAuley DF, Davies S, Gao F. Discrepancies between clinical and postmortem diagnoses in critically ill patients: an observational study. *Critical Care*. 2003; 7:129-132.
8. Pinto Carvalho FL, Cordeiro JA, Cury PM. Clinical and pathological disagreement upon the cause of death in a teaching hospital: analysis of 100 autopsy cases in a prospective study. *Pathol Int*. 2008; 58:568-571. doi: 10.1111/j.1440-1827.2008.02272. x.
9. Roulson J1, Benbow EW, Hasleton PS. Discrepancies between clinical and autopsy diagnosis and the value of postmortem histology; a meta-analysis and review. *Histopathol*. 2005. 47:551-559
10. Shojania KG, Burton EC, McDonald KM, Goldman L. Changes in rates of autopsy-detected diagnostic errors over time a systematic review. *JAMA* 2003; 289: 2849-2856
11. Shojania KG, Burton EC, McDonald, KM, Goldman L. The Autopsy as an Outcome and Performance Measure. AHRQ Evidence report summaries; 2002;58. Document present at: <http://archive.ahrq.gov/downloads/pub/evidence/pdf/autopsy/autopsy.pdf>
12. Tse GMK, Lee JCK. A 12-month review of autopsies performed at a university-affiliated teaching hospital in Hong Kong. *Hong Kong Med. J*. 2000; 6:190-194.
13. Birdi KS, Bunce DJ, Start R D, Cotton DW. (1996). Clinician beliefs underlying autopsy requests. *Postgrad. Med. J*.1996;72: 224-228.
14. Burton, JL, Underwood J. (2007). Clinical, educational, and epidemiological value of autopsy. *The Lancet* 2007; 369; 1471-1480.
15. Yawson, AE, Tette E, Tettey Y. Through the lens of the clinician: autopsy services and utilization in a large teaching hospital in Ghana. *BMC Res. Notes* 2014;7: 943. <https://doi.org/10.1186/1756-0500-7-943>