Determinants of Surgical Care and Outcomes for Patients with Appendicitis in a Tertiary Public Hospital with Tiered Services

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ABSTRACT

Background. Tiered services, differentiated by the financial capacity of patients and related payment arrangements with hospitals, are the norm in Philippine facilities. This study considered how these, together with selected demographic and clinical factors, were associated with surgical care utilization, provision, and outcomes for patients with appendicitis in a public university hospital.

Methods. This was a retrospective cohort study, utilizing data obtained from an electronic patient registry. Patients who underwent emergent appendectomies from January 2017 to December 2018 were included. Data were analyzed using multivariate and logistic regression, with the following dependent variables: time from symptom onset to emergency department consultation (ED Lag), time from consult to surgery (OR Lag), selection for laparoscopic appendectomy (LA), the occurrence of complicated appendicitis (CA), and length of stay (LOS). Morbidities and mortalities were tallied.

Results. There were 1,501 patients included in the study. Young adult males comprised the majority and mostly had non-private accommodations. Non-CA was the impression in more than 80% of cases. Extremes of age were associated with longer ED and OR Lags, greater likelihood of CA, and longer LOS. Patients initially assessed as having CA had shorter OR Lags, were less likely to undergo LA, and had longer LOS. Private patients were more likely to have undergone LA, lower CA odds, and slightly longer LOS.

Conclusions. Variations in surgical care utilization, provision, and outcomes for patients with appendicitis were independently associated with socioeconomic and clinical status differences.

Key Words: access to health care, appendicitis, laparoscopic surgery, outcomes assessment, socioeconomic factors

INTRODUCTION

Appendicitis is a common surgical condition. It is generally readily treatable through either open or laparoscopic surgeries and even non-operative means.[1] In the US, race and income inequalities are known to negatively affect access to the needed care.[2-4] These circumstances contribute to patients presenting with complicated appendicitis (CA), with consequent higher risks for adverse outcomes. Therefore, the extent to which structural barriers, notably financial constraints, work against optimal care for patients with appendicitis have been proposed as a bellwether of health system inequities.[5] A similar assessment of these circumstances is very relevant for the Philippines, as it moves towards a Universal Health Care (UHC) system meant to address existing health service disparities.[6]

The Philippines is a lower-middle-income country and has maintained a tiered health system. Patients who choose

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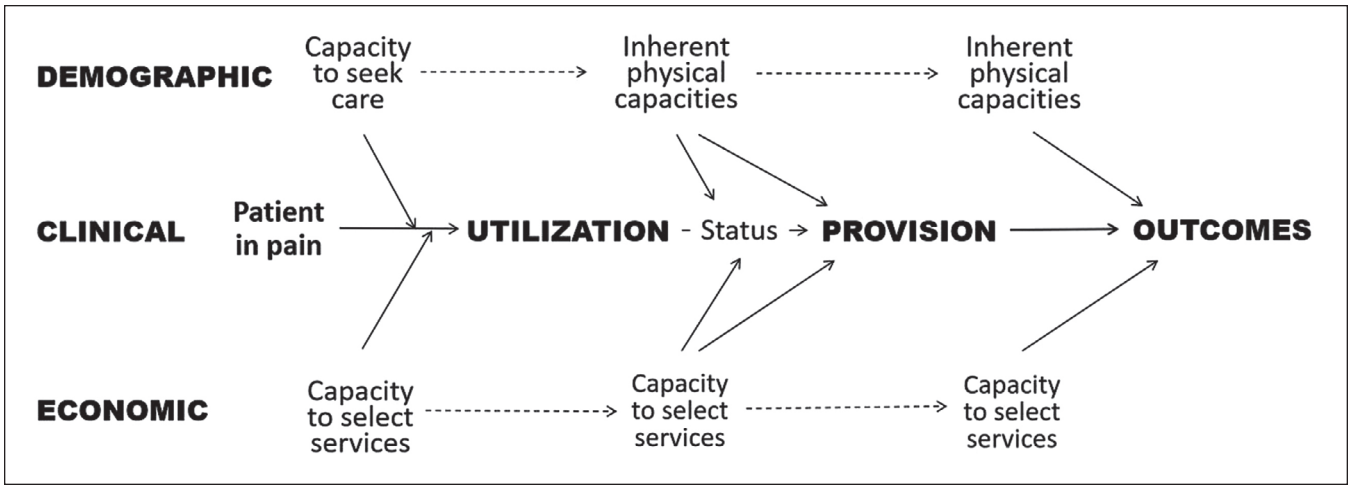

Figure 1. Model of the surgical care continuum and associated determinants.

private care are assumed to have the capacity to pay primarily out-of-pocket, with hospital charge balances settled by private insurance or PhilHealth, the national social health insurance agency. Those who utilize non-private services rely on public subsidies and PhilHealth support while often having to personally pay some amount still.

The Philippine General Hospital (PGH) is the county's leading public university hospital, and appendectomies are standard procedures for its surgical department. Patients are medically assessed at the emergency department (ED), and those with acute surgical abdomens are advised admission, with patients able to choose their room accommodation. As with most government hospitals, patients can avail of either non-private and a smaller number of private beds. Those with private accommodations can select their attending staff. Patients in non-private beds do not have this privilege.

The arrangements at PGH thus beg the question of whether public facilities with tiered services mitigates or aggravates existing health service disparities. An analysis of the differences in the care and outcomes for a common surgical emergent condition, to the extent that these are primarily attributable to social and demographic factors, can be an invaluable resource in assessing the relevance and responsiveness of the prevailing set-up in public hospitals. The evolving UHC policies can then be recrafted to better address the evident inequities in hospital services.

This study, involving patients who underwent appendectomies at PGH, was therefore undertaken to: describe the demographic, financing, clinical, and procedural patterns of these cases; identify which factors were associated with the utilization, provision, and outcomes of surgical care; and quantify their relationships.

METHODS

This was a retrospective cohort study, with data obtained from the Integrated Surgical Information System electronic registry of the PGH Department of Surgery. The University of the Philippines Manila Ethics Review Board approved the study protocol. The registry was accessed in April 2020, and data was retrieved using "appendectomy" as the search term and restricted to the specified dates. Included were patients listed as having undergone an appendectomy from 1 January 2017 to 31 December 2018. Patients whose initial impression or final diagnosis was not appendicitis yet had emergency surgeries with appendectomies done were also included. Excluded were cases of elective incidental appendectomies.

The conceptual model for the study is shown in Figure 1, which shows the interrelationships of demographic, economic, and clinical factors in the various stages of hospital care.

The regression equations utilized in the study were thus framed as follows, with the proxy hospital service utilization, surgical care provision, and patient outcomes values being the corresponding dependent variables:

Hospital Service Utilization

$$Lag_a = \alpha_1(\text{Demographic}) + \beta_1(\text{Economic})$$

Surgical Care Provision

$$Lag_b = \alpha_2(\text{Demographic}) + \beta_2(\text{Economic}) + \varepsilon_2(\text{Preop Assessment})$$

$$\text{Procedure} = \alpha_3(\text{Demographic}) + \beta_3(\text{Economic}) + \varepsilon_3(\text{Preop Assessment}) + \omega_3(Lag_b)$$

Patient Outcomes

$$\text{Intraop Diagnosis} = \alpha_4(\text{Demographic}) + \beta_4(\text{Economic})$$

$$\text{LOS} = \alpha_5(\text{Demographic}) + \beta_5(\text{Economic}) + \delta_5(\text{Intraop Diagnosis}) + \zeta_5(\text{Procedure})$$

Utilization was assessed in terms of variations in the ED Lag, the number of days that elapsed from the onset of symptoms to ED consultation. The assumption was that the latter was indicative of patients' (or their families') health-seeking behavior and the corresponding timing of provider access. The patient's age and gender, as well as economic status, were the related independent variables. The type of room accommodation was utilized as the proxy variable for the patient's financial status. Squared values of the patient's ages were generated to allow for extremes of age effects to be incorporated in the subsequent analysis. The OR Lag, or the number of days from ED consult to surgery, and the type of procedure were the dependent variables in evaluating surgical service provision. Demographic, economic, and preoperative clinical assessment parameters were the independent variables used for both, with OR Lag added for assessing LA use. The intraoperative finding of CA and LOS, or the number of days from ED consult to discharge, served as outcome measures. Demographic and economic factors were the independent variables used for the occurrence of CA. The same variables and whether there was an intraoperative diagnosis of CA or LA was the surgical approach were used for the LOS model.

STATA 10 software was used to produce descriptive summaries and perform regression analysis. The level of significance was at 0.05. Separate listings were made for co-existing conditions, complications, and deaths.

RESULTS

A total of 1,501 cases were included in the study. The descriptive statistics are presented in Table 1, with the continuous variables listed first. Most of the patients were males, young adults and had non-private accommodations. Private patients had, on average, one day less ED Lag. The data set for this included only cases wherein the onset of symptoms was indicated, or 760 patients, of which only 4 had private accommodations. While most patients were surmised to have non-CA at the ED, relatively more cases were assessed as having CA intraoperatively. Among those thought to have an acute surgical abdomen with a diagnosis other than appendicitis, 77% were considered intestinal obstruction from various conditions, such as malignancy or tuberculosis. The remaining 23% of cases were presumed to have other inflammatory conditions, such as cholecystitis and pancreatitis. There were several comorbidities recorded, which may have either required more medical attention (e.g., congenital heart disease, seizure disorder), posed diagnostic dilemmas (e.g., nephrolithiasis, leukemia, dengue), or affected surgical approaches (e.g., pregnancy,

Table 1. Summary statistics of study variables, appendectomy cases, PGH, 2017-2018

		Non-private (n=1412)		Private (n=89)	
		Mean	SD	Mean	SD
Age (years)		25.48	13.80	28.30	15.12
Time (days)	ED Lag[a]	2.30	2.24	1.31	1.18
	OR Lag	0.83	0.86	0.91	2.73
	Surgery to discharge	3.28	2.65	3.54	3.15
	LOS	4.09	2.78	4.45	4.63
		Count	% Frequency	Count	% Frequency
Gender	Male	926	65.6%	50	56.2%
	Female	486	34.4%	39	43.8%
Preop Assessment	Non-CA	1195	84.6%	74	83.1%
	CA	182	12.9%	9	10.1%
	With Obstruction	8	0.6%	0	0.0%
	Others	27	1.9%	6	6.7%
Intraop Diagnosis	Non-CA	877	62.1%	63	70.8%
	CA	532	37.7%	24	27.0%
	ruptured	472	88.7%	20	83.3%
	gangrenous	44	8.3%	4	16.7%
	with obstruction	9	1.7%	0	0.0%
	with peritonitis	7	1.3%	0	0.0%
	Not appendicitis	3	0.2%	2	2.2%
Procedure	OA	1183	83.8%	63	70.8%
	LA	212	15.0%	26	29.2%
	LA conversion	17	1.2%	0	0.0%

[a] *n=760, non-private=756, private=4*

situs inversus) for specific cases. Most patients underwent an open appendectomy (OA), but LA was more commonly done for private cases. Conversion to OA from an initial LA occurred only among non-private cases. Private patients tended to stay in the hospital, on average, a half-day longer.

The multivariate regression results for utilization are provided in Table 2. This again was based on the smaller data set with very few private cases. The constant value was nearly a three days' interval from onset of symptoms to ED consult. The shorter ED Lag for private patients was not statistically significant. Being male lengthened the ED Lag the most, but this difference was not significant. Age had a convex and significant association with ED Lag. The regression results regarding the provision of surgical care are provided in Tables 3 and 4. The consideration of another diagnosis was associated with nearly another day longer OR Lag, which was statistically significant, compared to those assessed to have non-CA. Patients considered to have CA, and more so among patients exhibiting signs of bowel obstruction, had a shorter lag. Age again had a significant convex relationship, but neither the patient's gender nor economic status had a considerable bearing on the timing of surgery. The logistic regression results for a laparoscopic approach indicate that, overall, this was twice as unlikely to be undertaken than OA. This was additionally more unlikely, and the trend is significant for patients with either CA or other conditions. Private patients, nonetheless, were more likely to undergo the procedure.

The logistic regression results for assessing the likelihood of CA at the time of surgery are presented in Table 5. These indicate that CA was more likely to be found in general and significantly more so, though only marginally, at extremes of age. Private accommodations reduced the likelihood of CA by half. As shown in Table 6, LOS, which had a constant of a little over five and half days, was markedly increased among patients with CA, except for those with gangrenous appendicitis. There were smaller, though statistically significant, increments in LOS associated with private patients and extreme ages.

Additional surgeries were performed in a few cases to address disease sequelae. Bowel repairs were done in 7 patients, and stomas were created for 5. There were 12 operative morbidities, including two wound hematomas, and five infectious complications (3 intra-abdominal abscesses, one sepsis, one pneumonia). There were four deaths, including one patient who required a stoma, all due to sepsis. The median age of those who died, all of whom had CA, was 3.2 years, with a mean LOS of 27 days.

Table 2. Multivariate regression results for Time from Onset of Symptoms to ED Consultation

		ED Lag			
		Coef.	SE	t	P>t
Constant		2.7597	0.2810	9.82	0.00
Demographic	Male	0.2295	0.1686	1.36	0.17
	Age	-0.0559	0.0201	-2.78	0.01
	Age-Squared	0.0009	0.0003	3.06	0.00
Economic	Private	-0.8955	1.1144	-0.80	0.42
		Number of observations			760
		R-squared			0.0155

Table 3. Multivariate regression results for Time from ED Consultation to Surgery

		OR Lag			
		Coef.	SE	t	P>t
Constant		1.2133	0.1083	11.21	0.00
Demographic	Male	-0.0360	0.0575	-0.63	0.53
	Age	-0.0265	0.0072	-3.68	0.00
	Age-Squared	0.0004	0.0001	3.74	0.00
Economic	Private	0.0214	0.1155	0.18	0.85
Preop Assessment	Complicated	-0.2399	0.0819	-2.93	0.00
	Obstruction	-0.5972	0.3745	-1.59	0.11
	Others	0.9175	0.1879	4.88	0.00
		Number of observations			1500
		R-squared			0.0356

Table 4. Logistic Regression results for Laparoscopic Appendectomy as the selected procedure

		LA as Procedure			
		Coef.	SE	z	P>z
Constant		-2.2139	0.3264	-6.78	0.00
Demographic	Male	0.1569	0.1545	1.02	0.31
	Age	0.0291	0.0208	1.40	0.16
	Age-Squared	-0.0003	0.0003	-1.07	0.29
Economic	Private	0.9016	0.2545	3.54	0.00
Preop Assessment	CA	-2.0787	0.4603	-4.52	0.00
	Others	-2.2442	1.0325	-2.17	0.03
Time	OR Lag	0.0767	0.0644	1.19	0.23
		Number of observations			1492
		Pseudo R-squared			0.0496

Table 5. Logistic regression results for Intraoperative Diagnosis of Complicated Appendicitis

		Intraop CA			
		Coef.	SE	z	P>z
Constant		0.9849	0.2128	4.63	0.00
Demographic	Male	0.0926	0.1162	0.80	0.43
	Age	-0.1187	0.0149	-7.98	0.00
	Age-Squared	0.0017	0.0002	7.77	0.00
Economic	Private	-0.4989	0.2506	-1.99	0.05
		Number of observations			1500
		Pseudo R-squared			0.0375

Table 6. Multivariate regression results for Length of Stay

		LOS			
		Coef.	SE	t	P>t
Constant		5.5785	0.3213	17.36	0.00
Demographic	Male	-0.2434	0.1417	-1.72	0.09
	Age	-0.1525	0.0180	-8.47	0.00
	Age-Squared	0.0021	0.0003	7.88	0.00
Economic	Private	0.6724	0.2854	2.36	0.02
Intraop Assessment	Ruptured	2.1134	0.1514	13.96	0.00
	Gangrenous	-0.0812	0.3868	-0.21	0.83
	Peritonitis	5.1914	0.8720	5.95	0.00
	With Obstruction	3.7612	0.9893	3.80	0.00
Procedure	OA	0.0475	0.1879	0.25	0.80
	Conversion	0.8964	0.6619	1.35	0.18
		Number of observations			1500
		R-squared			0.2174

DISCUSSION

With data collected retrospectively and based on a registry with only a few already–set data fields available, the study had several limitations. The electronic research term was "appendectomy" and not "appendicitis." The choice was made to exclude patients whose diagnoses had changed in the interim and for whom no appendectomies were done. This would have led to any cases undergoing non-operative management having been overlooked. There was only scant information regarding any intervening medical care, which may have affected subsequent surgical management and outcomes. There was no final diagnosis of a normal appendix listed (though a minority of cases had emergent surgeries for other abdominal pathologies, with appendectomies done incidentally), together with the lack of histopathologic data. The occurrence of negative appendectomies was not documented. Perioperative complications were limited to those which occurred and were tallied during inpatient confinement. Thus, morbidities which would have occurred after discharge, such as wound infections, may have been under-reported.

It was assumed that the relevant clinical parameters were adequately considered when the concerned surgical staff made the initial assessments of the patients. There may be confounding reasons for the choice of room accommodation, which may not accurately reflect the economic status of patients. The mitigating effects of social health insurance and other financing mechanisms, and the possibility that these could have affected patients' behavior, could not be factored in as these were not included in the registry data. It is with due consideration of these limitations that the study's findings should be interpreted.

There was a slight difference, though statistically insignificant, in ED Lag related to the patients' economic status. This, however, may also be misleading, given the small number of private patients in the corresponding data set. Income effects were significantly associated with delayed patient consultations in other settings, and similar compelling results may have been obtained had sufficient data been available for the current study.[2-4,7] More consistent with prior researches, the age of the patients had a bearing on the ED Lag. Very young patients may not be able to express their symptoms, and much older patients may also have limited means to seek care, contributing to undue delays.[8-10]

The PGH ED and operating rooms often function beyond their capacities, and access, therefore, needs to be prioritized. The results suggest that patients had been triaged for surgery based primarily on clinical grounds, as the OR Lag was indifferent to the financing measure used.[11] Those with CA, who stood to benefit most from prompt surgeries, had shorter OR Lags. Those at extreme ages or had other conditions stayed in the ED longer, possibly because additional tests or preparations had to be done.

While LA has become the procedure of choice in other settings, this is not yet the standard approach in the country.[12-15] LA is a more expensive option locally due to the added resource requirements and, where applicable, from higher provider fees. The results show that private patients were more likely to have undergone LA, implying a supplier-induced demand for this alternative.[16] In other countries, this has been reported to be less commonly performed for patients analogously categorized as non-private cases in public hospitals or otherwise among those who had less capacity to pay (which, in the US, pertain to those who are uninsured or have to self-pay, with higher payment default risks, or are covered by insurance with lower reimbursement rates).[7,17] Lower LA rates have thus also been considered as another indicator of inequitable patient care.[4,18] Interestingly, and also in the American setting, surgeons are reimbursed less for performing laparoscopic procedures.[19] On an institutional level, however, facilities that have a bias for LA rather than OA have been documented to have higher charges.[20]

LA could also have been offered just as frequently to non-private patients. They may have opted out, however, due to the anticipated added expense. PhilHealth has identical reimbursement rates for all appendectomy procedures and restricts additional hospital charges for indigent patients. Cost considerations would therefore have been neutral for qualified cases, enabling more laparoscopic surgeries for non-private patients. Unfortunately, there was no corresponding PhilHealth data to allow any further evaluations along this line. Additional charges, aside from those to be reimbursed by PhilHealth, are permitted for private patients. The latter would favor the provision of services with higher attendant fees. Laparoscopic equipment is also still limited and may have been rationed for private use. Likewise, the transition from open to laparoscopic surgery could have been ongoing during the period covered by the study, with OA still the default procedure, especially for resident trainees.

A corollary consideration may be that, setting aside financial and even technical concerns, LA may not have been the preference of the surgical trainees. They usually attend to non-private patients, and CA was more common in this group. OA may have been deemed as the more appropriate procedure for CA cases. A preoperative assessment of CA was independently associated with a lesser likelihood of LA. CA, while not an absolute contraindication to LA, is associated with higher conversion rates.[21,22] All the conversion cases in this study involved non-private patients with CA.

While extremes of age are often related to delays in treatment, these have also been shown to be independently associated with CA.[23-25] The disease process may already have been ongoing before the symptoms were noticed or reported by the younger or elderly patients, rendering the symptom-based time intervals unreliable measures. Private patients were found to be less likely to have CA. More well-off patients may have been better able to access timely care, possibly due to less aversion to the personal financial risks associated with hospital care. In settings where out-of-pocket payment arrangements do not apply, the reported income effects on the occurrence of CA have been inconsistent.[26,27] The difference has been speculated to arise from the variability of the magnitude of indirect costs, such as those for transportation, among low-income patients.[27]

As expected, patients at extreme ages or those with CA stayed longer in the hospital. The LOS of those with gangrenous appendicitis didn't vary from patients with non-CA, which connotes that disease severity and the required inpatient care did not differ substantially.[28] There was no significant difference in LOS between those who underwent OA and LA even though the latter has been touted as enabling a faster recovery.[1,13,14] Collectively, private patients tended to stay slightly longer in the hospital. This may be due to the patients' preferences for a longer inpatient recovery, or those of the attending staff. The converse may also hold, however, in that non-private patients may have wanted earlier discharges. With each incremental day of confinement, the financial burden, including lost wages for accompanying family members, would have been more significant for the less well-off patients.

While there were few morbidities and much fewer mortalities, the individual cases are still important. Overall, the count of adverse outcomes is below that of commonly reported levels, suggesting that these were under-reported in the present study.[29-31] The deaths predominantly involved pediatric patients, which highlight both the children's often worse status upon arrival at hospitals and the inadequacies in the related health care resources.[32,33] There were also hidden morbidities by way of possibly unnecessary surgeries. As non-CA comprised most appendectomy cases, many of these could have potentially been managed non-operatively and thereby avoided undue surgical risks and concomitant expenses.[1] The same would have applied for negative appendectomy cases, which were overlooked in the utilized registry.[34]

CONCLUSION

Overall, the study has shown that clinical and socio-economic factors were related to differences in surgical care utilization, provision, and outcomes for patients with appendicitis and related conditions. There were circumstances, such as delays in utilization for specific age groups, which were extrinsic to hospital-based interventions. The economic status of patients was, among others, a determinant particularly of the procedures undertaken for them. These are reflective of the barriers and patient selection biases attributable to tiered hospital services. These also result in inefficiencies in hospital services (e.g., duration of hospital stay determined not by clinical indication but economic status) and signify that health inequities remain unaddressed. Age and income status-related constraints are best mitigated by measures undertaken in the greater community. Though economic and political structures certainly bear upon these factors, public health interventions are equally important. Improvements in hospital systems are also warranted to prevent disease progression and ensure more adequate management for complicated cases. Particularly more attention will need to be given to pediatric patients.

While the data and insights pertained to a specific university hospital, similar circumstances apply to other public facilities in the country. The resulting disparities in the accessibility and provision of care should not be taken for granted. The situation described for emergent appendectomies epitomizes the difficulties that are engendered for patients with other similar medically urgent conditions. Forthcoming UHC interventions should therefore foster more responsive provider incentive structures, more rational delivery of services, and even greater public awareness on dealing with emergent health situations. These system-wide solutions will enable more equitable hospital services and thereby ensure better surgical outcomes for the affected patients.

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Statement of Authorship

The author contributed in the conceptualization, data acquisition and analysis, drafting and approved the final version submitted.

Author Disclosure

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