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The Private or Public Hospital: Where One Should Present with Appendicitis: A Systematic Review

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Introduction- Appendectomy for appendicitis remains the second most common urgent gastrointestinal surgery in the United States and one of the most common worldwide [1, 2]. Low socioeconomic status and a lack of private health insurance have been shown to have detrimental effects on the prognosis of patients with appendicitis [3-7]. Such patients experience higher rates of appendiceal perforation, which increases morbidity 10-fold. [8, 9]. They also attend hospital later, have reduced access to laparoscopic surgery and confront extended hospital stays and prolonged periods absent from work [3-7].

Private hospital emergency departments have helped offset the healthcare burden on public hospital emergency departments worldwide [10]. Patients presenting to private hospitals have the luxury of choosing and having better access to their treating surgeon and generally have access to a better-funded system of care. Previously it has been hypothesized that this will expedite diagnosis and therefore definitive care for conditions such as appendicitis through surgery [11]. Furthermore, privately-treated patients will more likely be operated upon by a specialist surgeon with more advanced equipment [4, 8, 11].

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The Private or Public Hospital: Where One Should Present with Appendicitis: A Systematic Review

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I. INTRODUCTION

Appendectomy for appendicitis remains the second most common urgent gastrointestinal surgery in the United States and one of the most common worldwide [1, 2]. Low socioeconomic status and a lack of private health insurance have been shown to have detrimental effects on the prognosis of patients with appendicitis [3-7]. Such patients experience higher rates of appendiceal perforation, which increases morbidity 10-fold. [8, 9]. They also attend hospital later, have reduced access to laparoscopic surgery and confront extended hospital stays and prolonged periods absent from work [3-7].

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We set out to test whether these perceived advantages play out in reality. The primary aim of this systematic review was to compare the outcomes of patients admitted to public and private hospitals with appendicitis. The secondary aims were to compare the patient characteristics and operative details, such as access to laparoscopic surgery, of these two patient groups.

II. METHODS

a) Search Strategy

Beginning on the 15th February 2018, four databases were systematically searched by two reviewers (MB, TL) and involved articles up to and

reviewers (MB, TL) and involved articles up to and including the 16th of February, 2018. The search terms used were (1) (public OR university OR government) AND (private OR university) AND appendi*. We performed a manual reference check of each of the included studies.

b) Inclusion Criteria

Studies that compared appendectomies performed in public and private hospitals were included in our piece. Assessment of paper eligibility was made by two researchers (MB, TL). There were no restrictions regarding country or language of publication. Consideration was given to all age groups. There was no limitation on study design. Published abstracts were considered for inclusion.

c) Exclusion Criteria

We excluded studies devoid of a control group. Unpublished data was deemed ineligible.

d) Data Extraction

Pre-operative data such as demographics, clinical findings and investigations, operative findings such as duration and rates of laparoscopic approach and postoperative results such as complication rates and length of stay were extracted independently by two reviewers (MB, TL).

III. RESULTS

The initial search elicited 258 citations and the manual reference check a further six (Figure 1). Once duplicates were discarded and titles reviewed, fifty-four abstracts were analyzed. Fourteen papers were identified for full-text appraisal and of these, six met the inclusion criteria, with a combined 1112 patients [5, 11-15]. The articles were a mixture of prospective [14] and retrospective [5, 11-13, 15] case-control trials. Two studies were produced in Brazil and the remaining four were carried out in Australia [12], South Africa [14], the USA [15] and France [5], respectively (Table 1). One study was undertaken in pediatric facilities only [15] and the remainder were conducted in majority adult facilities [5, 11-14].

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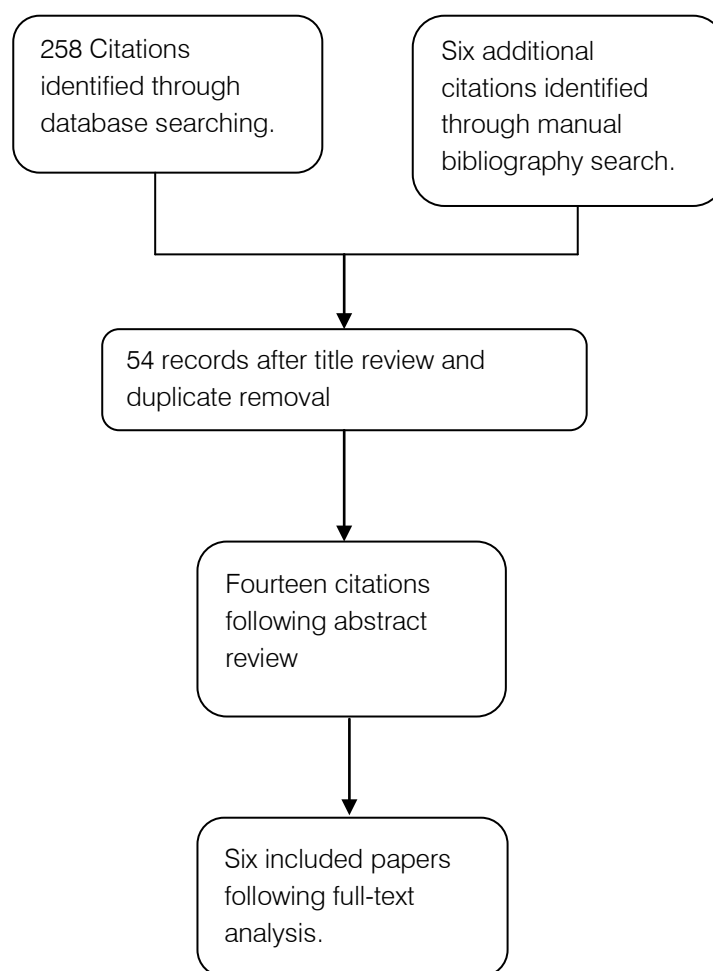


Figure 1: Systematic search strategy

Table 1: Study characteristics. Pub = public, priv = private. *Analysis was performed on cohort following removal of cases of perforation

Study	Nationality	Study type	Hospitals (pub/priv)	No. hosp priv	Period of study	Patient numbers (pub/priv)	Number female (pub/priv)
Coelho 2010 [11]	Brazil	Retrospective case control	1	1	2007-2009	100/100	46/56
Yang 2015 [14]	South Africa	Prospective case control	2	3	2013-2014	73/61	36/30
Steinman 2013 [13]	Brazil	Retrospective case control	1	1	2010	111/143	44/74
Zilbert 2009 [15]	USA	Retrospective case control	1	1	2004-2008	100/155 (84/134)*	31/84
Lienhart 2003 [5]	France	Retrospective cohort	Nation-wide		1996	2847	
Mackrill 2014 [12]	Australia	Retrospective case control	1	1	13-month period not specified	164	87/55

*Analysis was performed on cohort following removal of cases of perforation

a) *Timing*

Five papers compared the timing of the preoperative journeys of public and private patients with appendicitis [11-15]. Steinman *et al.* (2013) found public patients presented after a significantly longer duration of symptoms (48 vs. 24hrs; $p<0.001$). However, both Yang *et al.* (2015) (56.2 vs. 49.2hrs; $p=0.360$) and Zilbertet *al.* (2009) (24 vs. 24hrs) found no such disparity. Coelho *et al.*, 2010, found public patients waited a mean of 72 hours from symptom onset to appendectomy, compared with private patients' 36 hours ($p<0.001$). Steinman *et al.*, 2013 (12 vs. 9 hours; $p<0.001$) and Mackrillel *al.*, 2014 (median 13 vs. 9.5hrs) both found public patients waited longer from presentation to operation [12, 13]. Mackrillel *al.*, 2014, found that 12.2% of public and 4.8% of private patients were operated on greater than 24hrs after presentation [12]. The authors also report that 111 of their 164 public cases (68%) were performed outside of normal working hours (0800-1700), compared with 55 of 105 (52%) private patients.

b) *Preoperative Characteristics*

Three studies examined the preoperative clinical parameters of public and private patients to varying degrees. Coelho *et al.* (2010) was the only study to compare the presenting symptoms of patients presenting to public and private hospitals [11]. In their cohort out of Brazil, they found the public patients presented with significantly more diarrhea (19% vs. 8%; $p<0.001$), while suggestive abdominal pain, anorexia, nausea and vomiting were evenly distributed between the cohorts. Regarding signs, fever was significantly more prevalent in public patients (41% vs. 15%; $p<0.001$), whereas abdominal tenderness and rebound tenderness were present in equal measure [11]. Yang *et al.* (2015) found fever to exist equally amongst public and private patients presenting with appendicitis [14]. Heart rate (99.6 vs. 85.5 beats/min; $p=0.002$) and diastolic blood pressure (76.6 vs. 72.8mmHg; $p=0.030$) were both higher in their public hospital cohort.

Coelho *et al.*, 2010, found that a significantly larger number of public patients were reviewed by a physician prior to surgeon assessment (85 vs. 13; $p<0.001$). The authors argued that this was likely a significant factor in these patients' delay to operation and therefore perforation [11].

c) *Investigations*

Both Yang *et al.* (2015) (15.8 vs. 13.4 $\times 10^9$ cells/L; $p=0.071$) and Zilbertet *al.* (2009) (16.6 vs. 4.5 $\times 10^9$ cells/L; $p=0.030$) found public patients' white blood cell counts to be significantly higher [14, 15]. Yang *et al.* (2015) also found CRP to be significantly elevated in public patients relative to private (202.2 vs. 72.8mg/L; $p<0.001$).

There was discordance amongst the studies regarding the number of imaging studies performed prior to operation. Mackrillel *al.*, 2014 and Steinman *et*

al., 2013, found that imaging was requested at higher rates amongst private patients [12, 13]. Mackrillel *al.* reported that 19 and 20 public patients received ultrasound and CT abdomen scans, respectively, versus 16 ultrasounds and 42 CT scans in the private cohort. Steinman *et al.*, found that 34 ultrasounds and 9 CT scans were performed on public patients compared with 67 ultrasounds and 20 CT scans in their private patients ($p<0.001$). Zilbertet *al.*, 2009 discovered that although imaging in some form was requested equally in public and private patients (77% vs. 77%), CT scans were significantly more prevalent in the public cohort (36% vs. 21%; $p=0.02$) [15]. Coelho *et al.*, 2010, discovered that ultrasound scans were effected significantly more frequently in the public population (56% vs. 30%; $p<0.001$) [11].

d) *Operations*

Rates of laparoscopic vs. open surgeries were inconsistent amongst the included studies. Coelho *et al.*, 2010 (22% vs. 86%; $p<0.001$) and Yang *et al.*, 2015 (25% vs. 48%; $p=0.003$) found the laparoscopic approach was used more with private patients [11, 14]. However, Zilbertet *al.*, 2009 (76% vs. 54%; $p=0.002$) found that public patients underwent proportionally more laparoscopic surgeries than private patients [15]. All patients in the piece by Mackrillel *al.*, 2014, underwent laparoscopic surgery [12]. In a search for factors predictive of the use of a laparoscopic approach in French appendectomies, Lienhartet *al.*, 2003, found that private patients had an adjusted odds ratio of 2.7 relative to public patients [5]. Nine public patients of Yang *et al.*'s required conversion to an open procedure. None of their private patients required conversion [14].

Steinman (55.9% vs. 46.5%; $p=0.011$), Yang (41% vs. 23%; $p=0.026$), Mackrill (22% vs. 10%; $p=0.008$) and Coelho (37% vs. 21%; $p=0.013$) found significantly higher rates of appendiceal perforation in the public cohorts of their studies. Zilbert (19% vs. 13%) found no significant difference between cohorts.

Yang *et al.*, 2015, were the only group to investigate differences in operation duration between the groups. They found public cases typically took more than half an hour longer to complete (1.7 vs. 1.1hrs; $p<0.001$).

e) *Negative appendectomy rates*

Only one of each of Steinman *et al.*'s (2013) public (1%) and private (1%) patients had a negative appendectomy [13]. Yang *et al.*, 2015, found the rate of histologically normal appendices were similar between groups (13.9% vs. 5.7%; $p=0.076$) [14]. Mackrillel *al.*, 2014, had 13.4% negative appendectomies in their public cohort and 16% in their private cohort [12]. Coelho *et al.*, 2010 and Zilbertet *al.*, 2009, included only patients with true appendicitis.

f) Complications

Public operations were more likely to end in complications according to Coelho *et al.*, 2010 (36% vs. 20%; $p=0.012$) and Steinman *et al.*, 2013 (18% vs. 8%; $p=0.024$) [11, 13]. Yang *et al.*, 2015, found no difference between the cohorts (30% vs. 26%; $p=0.617$), as did Zilbertet *et al.*, 2009 (12% vs. 11%; $p>0.05$) and Mackrille *et al.*, 2014 (7% vs. 9%; $p=0.817$).

Regarding individual complications, Coelho *et al.*, 2010, found wound infections were significantly more common in public patients (22% vs. 11%; $p=0.036$). Abscess formation, incisional hernias, atelectasis, urinary retention, urinary tract infections and thrombophlebitis were equal between groups [11]. Yang *et al.*, 2015, deemed ileus more prevalent in the public cohort (7% vs. 0%; $p=0.045$). Wound infection, fistula formation and pneumonia were not different [14]. Mackrille *et al.*, 2014, found similar numbers of abscesses, wound infections and episodes of ileus and urinary retention between their public and private cohorts [12].

Two cases of appendicitis died during the course of the included studies. Both were public patients in the study by Yang *et al.*, 2015 [14].

g) Length of hospital stay, readmission and time to resumption of activities

Public patients spent significantly longer periods in hospital than their private comparisons in each of the four studies that investigated the outcome [11, 13-15]. Coelho *et al.*, 2010, found public patients stayed a day longer (3.5 vs. 2.5 days; $p=0.002$), as did Zilbertet *et al.*, 2009 (2 vs. 1 day; $p<0.001$) [11, 15]. Steinman *et al.*, 2013, found public patient's length of stay was 2.2 days longer (4 vs. 1.8 days; $p<0.001$) and Yang *et al.*, 2015 found theirs to be 2.4 days longer (5.3 vs. 2.9; $p=0.036$) [13, 14].

Coelho *et al.*, 2010, had four readmissions in their public cohort and one in their private cohort (4% vs. 1%; $p=0.174$) [11]. Yang *et al.*, 2015, had six public readmissions and three private (8.2% vs. 4.9%; $p=0.344$) [14].

Coelho *et al.*, 2010, found public patients took 16.8 days longer than their private comparisons to resume normal daily activities (33.2 vs. 16.4 days; $p<0.001$). Similarly, Yang *et al.*, 2015, found public patients returned to work after 23 days, against private patients' 12.1 days [4, 8, 11]s ($p<0.001$).

IV. DISCUSSION

Ours is the first systematic review comparing public and private hospital's care of patients with appendicitis. The published literature on this topic is sparse and conducted in variable healthcare systems. Nevertheless, the widespread utilization of private hospitals as emergency healthcare facilities

necessitates an update on the state of care offered by them [16].

Many of the trends in the data seem to transcend the heterogeneity of their original studies. From the included studies, it appears that patients presenting to and being cared for within public institutions present later and with more complicated disease. This presentation is the first in a series of steps in the patient's hospital journey that concludes with a prolonged stay and relative difficulty in returning to normal life. The intervening steps include delays in reaching the operating theatre, reduced access to laparoscopic surgery, prolonged theatre operating times and increased operative complication rates [5, 11-15].

Previous investigations of the relationship between appendiceal perforation and health insurance status or socioeconomic status have varied in their conclusions. In a retrospective analysis of appendicitis presentations to hospitals in Canada and the USA, Krajewski *et al.*, 2009, found that uninsured Americans were more likely to present to hospital with a perforated appendix than those with insurance [4]. They also found that risk of perforation had a significant and inverse relationship to income in the United States, the risk of perforation increasing with each reduction in income quintile. Conversely in Canada, where health insurance is universal, the authors discovered that poorer population groups were no more likely to present to hospital with complicated appendicitis than the richest quintile [4]. In a study of Greek patients with appendicitis, Papaziogas *et al.*, 2009, found no difference in perforation rate with varying insurance status [9]. Similarly, in their study out of New York, Bickell *et al.*, 2006, found no relationship between insurance status and perforation rates [17].

Despite this variation in the literature, our study's finding that as a group, public patients present more unwell and yet take longer to receive definitive care in the form of surgery, is particularly concerning. For instance, despite Steinman *et al.*'s (2015) public cohort experiencing 20% more perforations at presentation, their private cohort underwent surgery three hours earlier [13]. Such findings obviously require further investigation and if proven consistent, demand institutional and systemic redress.

Laparoscopic appendectomy is safer than open surgery and allows patients a faster postoperative recovery [18-20]. Complications such as wound infection and ileus are increased with open surgery [18, 20]. Laparoscopy being more expensive and requiring specialized equipment, uninsured, non-white patients, and those presenting to low-volume facilities are less likely to receive it [2-4, 8, 11]. We found that this disparity holds with regards to public and private hospitals, which will likely have contributed to the overall increase in complications in public hospital patients.

Our study is quite limited by the scarcity of published studies available for comparison and is a strong indicator that more data is required from more institutions. Our study crosses national boundaries and hence compares articles founded in different healthcare systems, limiting its value. The inclusion of pediatric data, while broadening the scope, similarly limits the comparability of the papers. Operative data offered by each paper was truncated, with no description of technique or laparoscopic equipment used. Each paper analysed had incomplete outcome data. The quality of the included studies is restricted, with five of the six being retrospective in nature and none of them being randomized.

V. CONCLUSION

This is the first systematic review analyzing the outcomes of cases of appendicitis treated at public and private hospitals. Our study suggests that patients treated at public hospitals have more complicated disease, receive more basic care at a later time point and suffer more operative complications and a longer hospital stay. There is a concerning dearth of literature on this topic and this report highlights the need for further research.

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