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Original Research

Communication and management of incidental pathology in 1,214 consecutive appendicectomies; a cohort study

Ned Kinnear[a,b,c,*], Bridget Heijkoop[a], Eliza Bramwell[b], Alannah Frazzetto[b,c], Amy Noll[b,c], Prajay Patel[b,c], Derek Hennessey[d], Greg Otto[a], Christopher Dobbins[e], Tarik Sammour[e,f], James Moore[e,f]

[a] Dept of Surgery, Lyell McEwin Hospital, Adelaide, Australia
[b] Dept of Surgery, Port Augusta Hospital, Port Augusta, Australia
[c] Adelaide Medical School, University of Adelaide, Adelaide, Australia
[d] Dept of Urology, Mercy University Hospital, Cork, Ireland
[e] Dept of Surgery, Royal Adelaide, Hospital, Adelaide, Australia
[f] Dept of Surgery, Faculty of Medical and Health Sciences, University of Adelaide, Adelaide, Australia

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ABSTRACT

Background: Important incidental pathology requiring further action is commonly found during appendicectomy, macro- and microscopically. We aimed to determine whether the acute surgical unit (ASU) model improved the management and disclosure of these findings.

Methods: An ASU model was introduced at our institution on 01/08/2012. In this retrospective cohort study, all patients undergoing appendicectomy 2.5 years before (Traditional group) or after (ASU group) this date were compared. The primary outcomes were rates of appropriate management of the incidental findings, and communication of the findings to the patient and to their general practitioner (GP).

Results: 1,214 patients underwent emergency appendicectomy; 465 in the Traditional group and 749 in the ASU group. 80 (6.6%) patients (25 and 55 in each respective period) had important incidental findings. There were 24 patients with benign polyps, 15 with neuro-endocrine tumour, 11 with endometriosis, 8 with pelvic inflammatory disease, 8 *Enterobius vermicularis* infection, 7 with low grade mucinous cystadenoma, 3 with inflammatory bowel disease, 2 with diverticulitis, 2 with tubo-ovarian mass, 1 with secondary appendiceal malignancy and none with primary appendiceal adenocarcinoma. One patient had dual pathologies. There was no difference between the Traditional and ASU group with regards to communication of the findings to the patient ($p = 0.44$) and their GP ($p = 0.27$), and there was no difference in the rates of appropriate management ($p = 0.21$).

Conclusion: The introduction of an ASU model did not change rates of surgeon-to-patient and surgeon-to-GP communication nor affect rates of appropriate management of important incidental pathology during appendectomy.

1. Introduction

Globally, appendicectomy is consistently the first or second most common emergency general surgical procedure [1–5]. Unexpected findings occur in 3–14% of patients undergoing appendicectomy [6–9]. Reported important macroscopic incidental pathologies include diverticulitis, endometriosis, inflammatory bowel disease, Meckel's diverticulitis, pelvic inflammatory disease and tubo-ovarian mass [6,10–18]. Similarly, reported incidental microscopic pathologies include benign polyps, endometriosis, *Enterobius vermicularis* or schistosomal infection, neuro-endocrine tumour and primary or secondary malignancy [6–8,10–16,18–25]. However, most studies only detail the microscopic histopathological incidence, with only a handful describing patient management and follow-up [6,7,15,26–28].

Separately, the acute surgical unit (ASU) model has enjoyed broad uptake in Australasia since its introduction 2005 [29]. Compared with the Traditional model of managing emergency general surgical referrals, the ASU provides an on-site registrar, on-call consultant and ready emergency theatre, all available 24 h a day. The core objectives of this model are faster patient care and a reduction in after-hours

* Corresponding author. Department of Surgery, Lyell McEwin Hospital, Haydown Rd, Elizabeth Vale, SA 5112, Australia.
E-mail address: ned.kinnear@adelaide.edu.au (N. Kinnear).

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operating. Centres introducing the ASU model have routinely reported achieving these benefits, as well as fewer complications, improved staff satisfaction and reduced cost [1,5,30–32].

In our metropolitan tertiary referral hospital, staffing for emergency general surgical presentations changed from the Traditional to the ASU model on 01 August 2012. While improved patient disclosure and follow-up was not a pre-defined objective of this transition, the authors hypothesised that the greater provision of staffing specific to emergency general surgery would improve disclosure and follow-up. Hence, this study aims to assess whether the introduction of an ASU impacted the communication and management of important incidental pathology in patients with important incidental findings during appendicectomy at our site.

This investigation was stimulated by local quality and safety initiatives, and an appreciation of the paucity of relevant literature. Despite numerous studies of the ASU model, to date none have examined the frequency of incidental pathology following appendicectomy or any procedure, nor the impact of the new model on its communication or management [2,5,33].

2. Materials and methods

In this retrospective cohort study, all adult patients undergoing appendicectomy at our institution during the Traditional (01/02/10–31/07/12) and ASU periods (01/08/12 - 01/02/15) were enrolled. Eligible patients were aged ≥18 years, underwent appendicectomy (Medicare Benefits Schedule code 30571 or 30572) and had complete data available. Patients with incidental pathology were identified from their operation note or histopathology report. Data were collected by interrogation for every appendicectomy patient of the above documents, as well as their discharge summary. Hard copy medical records were also assessed for all patients with incidental pathology. Primary outcomes were rates of documentation of communication of important incidental findings to the patient within three months, to their GP within three months, and rates of documentation of appropriate management or follow-up within six months.

Important incidental pathology was defined as findings, either macroscopic intra-operatively or microscopic on subsequent histopathology, which required additional treatment or follow-up, or referral to a non-general-surgical speciality. Satisfactory communication to the patient of important incidental *macro*scopic findings required documentation of informing the patient during their index admission. Satisfactory patient communication of important incidental *micro*scopic findings required documentation of its mention within three months during a scheduled outpatient consultation. When an outpatient consultation was scheduled but the patient failed to attend, communication to the patient and appropriate follow-up were recorded as satisfactory.

Satisfactory communication to the patient's GP of important incidental pathology required either its mention in the index admission discharge summary (which are automatically posted to the GP), or evidence in the hard-copy notes of its mention within three months in an outpatient letter or multi-disciplinary team (MDT) meeting letter addressed to the GP. Appropriate care for each condition was guided by the literature and relevant guidelines (Table 1). Instances where patients received some, but not all, of the recommended care items for their pathology were assessed as either satisfactory or not through inter-author discussion. Macroscopic findings of retrograde menses, ovarian cyst rupture, and unruptured ovarian cysts < 3 cm were assessed as needing no specific follow-up, and not included in this study.

We have previously described our acute surgical unit structure, handover routine and preliminary results [1,33,34]. This study was performed in accordance with the Declaration of Helsinki and reported in line with the STROCSS criteria [35]. This trial was logged with the Australian New Zealand Clinical Trials Registry (ACTRN12619000857101). Ethics approval was obtained (see Author Disclosure Statement).

2.1. Statistical analysis

Continuous data with non-parametric distribution (patient age) were summarized as medians with interquartile range (IQR), and significance assessed using the Wilcoxon (Mann–Whitney) test. Continuous data with parametric distribution were summarized as means with standard deviation (SD) and significance assessed using Student's t-test. Categorical measures were summarized as proportions and assessed with Pearson's chi-square test. All tests were two-tailed, and significance was assessed at the 5% alpha level.

3. Results

3.1. Demographics

In the enrolment period, 1,214 eligible patients underwent appendicectomy, with 465 and 749 patients in the Traditional and ASU periods respectively. The cohorts were similar in gender, median age and American Society of Anaesthesiologists physical status score 1. However, there was a significant trend towards more severe laparoscopic appendicitis grade in the Traditional cohort [36] (Table 2).

3.2. Primary outcomes

Important incidental pathology was found in 80 patients; 25 (25/465; 5.3%) and 55 (55/749; 7.3%) in the Traditional and ASU periods respectively. These included 15 (1.2%) with neuro-endocrine tumours, 11 (0.9%) with endometriosis, 8 (0.7%) with *Enterobius vermicularis* infection, 8 (0.7%) with pelvic inflammatory disease, 7 patients (0.6%) with low grade mucinous cystadenomas and 3 (0.2%) with inflammatory bowel disease (Table 2). All patients had a single pathology except for one patient in the ASU period, whose appendiceal histology revealed both endometriosis and a low-grade mucinous neoplasm. No patient had missing outcomes data.

When important incidental pathology was detected, more than three-quarters of patients were informed within three months, without a significant difference between the two periods (84% vs. 76%; p = 0.44). Both groups had similar rates of correspondence within three months to the patient's general practitioner regarding the incidental pathology (84% vs. 73%; p = 0.27). Lastly, rates of appropriate management within six months of important incidental pathology were equivalent (84% vs. 71%; p = 0.21) (Table 2).

The twenty patients who did not receive appropriate prompt treatment comprised five patients with sessile serrated adenomas (SSA), four with *Enterobius vermicularis* infection, four with endometriosis, three with neuro-endocrine tumours, two with low grade (LG) tubular adenomas, one with LG mucinous cystadenoma and one with suspected inflammatory bowel disease (Table 3). Only three of these patients were informed of their pathology, named one each with SSA, LG tubular adenoma and LG mucinous cystadenoma. Seventeen patients had no further management of any kind, while three patients had partial but inadequate or unrelated further care. Specifically, one patient with LG mucinous cystadenoma (non-perforated and without extra-appendiceal mucin) declined colonoscopy, was not referred to MDT and was discharged and a second with neuro-endocrine tumour was investigated one year later for per rectal bleeding with an unremarkable colonoscopy. A third and final patient with an appendiceal SSA had a colonoscopy three years later following positive screening faecal occult blood test, with the finding of multiple polyps leading to elective total colectomy.

4. Discussion

Contrary to this study's hypothesis, introduction of an ASU was not associated with improvements in communication or management of important incidental pathology in patients undergoing

Table 1
Optimal management criteria for important incidental pathology from appendicectomy.

Condition	Management
Appendiceal neoplasms - Primary	
Epithelial	
Benign	
Serrated sessile adenoma	Colonoscopy in < 6 months, or 5 years from last, whichever is later[a] [47, 48].
Low grade tubular adenoma	Colonoscopy in < 6 months, or 5 years from last, whichever is later[a] [47, 48].
Low grade villous adenoma	Colonoscopy in < 6 months, or 3 years from last, whichever is later[a] [47, 48].
Malignant	
Low grade mucinous neoplasm	Counseling of diagnosis. MDT discussion. No follow-up in most [49, 50]. If both appendiceal perforation and extra-appendiceal mucin are present, offer serum tumour markers, CT AP and referral to a specialist centre[b] [49]. If appendiceal perforation but not extra-appendiceal mucin is present, and lesion is macroscopically removed, offer colonoscopy, and serum tumour markers[c] and CT AP annually [49].
High grade mucinous neoplasm/ adenocarcinoma	Counseling of diagnosis. Colonoscopy in < 6months. MDT discussion. If completely resected pathologic stage T*is* or favourable risk T1, offer repeat colonoscopy in 12 months. If incompletely resected, high risk T1 (high grade atypia, lymphovascular invasion) or T2≤, offer CT AP and right hemicolectomy [49,51,52].
Non-epithelial	
Neuro-endocrine tumours	Counseling of diagnosis. MDT discussion. No follow-up in most[d] [53]. Offer right hemi-colectomy if any of: lesion > 2 cm, positive margin or involves meso-appendix[e] [49,53,54]. These patients require long-term follow up.
Appendiceal neoplasms - Secondary	
Melanoma	Counseling of diagnosis. CT AP. MDT discussion. Cutaneous examination for primary. Proceed based on findings.
Non-appendiceal - Gynaecological	
Endometriosis	Referral to gynaecology.
Pelvic inflammatory disease	Testing for sexually transmitted infection. Empiric antibiotic therapy with ceftriaxone, metronidazole and azithromycin[f] [55]. Referral to gynaecology to confirm clearance and discuss fertility implications.
Tubo-ovarian mass	Referral to gynaecology[g].
Non-appendiceal – Other	
Large bowel diverticulitis	Minimum five days of antibiotic therapy [56]. Offer colonoscopy [57].
Crohn's disease	Referral to gastro-enterology[h].
Enterobius vermicularis infection	Anthelmintics (e.g. mebendazole, albendazole, pyrantel) oral single dose [58].

Appendiceal neoplasm classification in keeping with Murphy et al. [49].
CT AP: computed tomography scan abdomen/pelvis. MDT: multi-disciplinary team. NET: neuro-endocrine tumours.

[a] Joint Australian guidelines recommend that when adenomas are resected but the colon has not been fully cleared of adenomas, then colonoscopy be performed 3–6 months post-op [48]. For low grade tubular adenomas and sessile serrated adenomas, these guidelines recommend repeat colonoscopy at 5 years. For adenomas with villous features or high grade dysplasia, these guidelines recommend repeat colonoscopy at 3 years [47].

[b] To consider cytoreductive peritonectomy and heated intraperitoneal chemotherapy, to reduce the risk of developing pseudomyxoma peritonei syndrome [49].

[c] Colorectal tumour markers include carcinoembryonic antigen, cancer antigen-125 and cancer antigen-19-9.

[d] For NETs not meeting criteria for hemicolectomy, follow-up is controversial. Options include surveillance CT AP, urine 5-hydroxyindoloacteic acid or serum chromogranin-A. Guidelines do not recommend specific follow up [53].

[e] Additional histological factors supporting right hemicolectomy include high mitotic index (≥2 mitoses per mm^2), high Ki-67 index (≥2% cells staining positive for Ki-67), lymphovascular invasion, involved lymph nodes, adenocarcinoid type and moderate or high grade atypia [49,54].

[f] Antibiotic route and duration tailored to disease severity [55].

[g] Tubo-ovarian masses include hydro-salpinx, ectopic pregnancy and suspected ovarian mass. These should ideally be referred intra-operatively. Gynaecological workup may include pelvic ultrasound, and serum tumour markers beta human chorionic gonadotrophin, alpha fetoprotein and cancer antigen-125.

[h] For counseling and offering of gastroscopy/colonoscopy to confirm diagnosis.Table 2: Patient demographics and incidental findings.

appendicectomy. While the management of twenty patients fell below accepted standards (Table 4), some of these omissions held more consequence than others. In ten (e.g. half) of these patients, the failure to obtain ideal management likely held minimal harm. Specifically, the three patients with appendiceal neuro-endocrine tumour received curative resection, and the accepted standard of care that they lacked (MDT discussion) would have added little. Similarly, case note review (data not shown) revealed that the three patients with microscopic evidence of endometriosis were not otherwise symptomatic from this disease. Finally, while four patients had evidence of *Enterobius vermicularis* infection, this disease is often cleared by the host, is well suited to community-based detection and has no reported deaths in Australia. In contrast, for ten patients, certain investigations or referrals would have been advantageous. This included the seven patients with appendiceal mucosal adenomas, who warranted colonoscopy for their elevated risk of synchronous colonic polyps. Similarly, the patient with a low grade mucinous neoplasm with mucin extending into the meso-appendix would have been more comprehensively managed with serum tumour markers, contrast computed tomography scan of the abdomen and pelvis, and referral to a multi-disciplinary team meeting. Lastly, the two patients with macroscopic evidence of endometriosis or Crohn's disease respectively clearly had symptomatic disease, and warranted specialist referral.

Patient communication is a cornerstone of surgical practice and non-technical skills [37]. However, little research exists objectively measuring communication rates of outcomes in emergency general surgery. To locate relevant studies, a literature review was performed using databases Medline, Embase and the Central Register of Controlled Trials. These searched the titles and abstracts of English language studies published from any date prior to 21 February 2019. Search terms were *(appendicectomy OR cholecystectomy OR hernia OR general surgery) AND (communication OR disclosure) AND (patient OR general practitioner OR family physician OR family doctor OR family practitioner OR local medical officer)*. From 764 total results including 533 unique studies, five full text articles were reviewed. Of these, a single quantitative study in general surgery was identified concerning post-operative surgeon-to-patient or surgeon-to-general practitioner communication. This British retrospective study assessed patients undergoing laparoscopic surgery for right iliac fossa pain [38]. Amongst the 55 patients who returned the questionnaire, 100% reported being informed of their intra-operative diagnosis as either an in- or out-patient, although written record of this disclosure existed for only 14%. Furthermore, five

Table 2
Patient demographics and incidental findings.

	Traditional period (n = 465)	ASU period (n = 749)	P value
Female (%)	257 (55%)	419 (56%)	0.82
Median age (mean ± SD) (years)	29 (33 ± 14)	30 (34 ± 14)	0.13
ASA 1 (%)	277 (60%)	417 (56%)	0.38
ASA 2 (%)	174 (37%)	304 (41%)	[a]
ASA 3 (%)	14 (3%)	28 (4%)	[a]
Laparoscopic grade of appendicitis (45)			
0 - normal looking appendix	103 (22%)	166 (22%)	0.003
1 - inflamed appendix	268 (58%)	471 (63%)	[a]
2 - appendiceal necrosis, with nil/minimal peri-colic fluid	23 (5%)	40 (5%)	[a]
3 - phlegmon or abscess	18 (4%)	33 (4%)	[a]
4 - perforation, diffuse peritonitis or peritoneal free air	53 (11%)	39 (5%)	[a]
Appendiceal neoplasms - Primary			
Epithelial			
Benign			
Serrated sessile adenoma	1	18	
Low grade tubular adenoma	0	4	
Low grade villous adenoma	0	1	
Malignant			
Low grade mucinous neoplasm	2	5[b]	
High grade/ adenocarcinoma	0	0	
Non-epithelial			
Neuro-endocrine tumours	9	6	
Appendiceal neoplasms - Secondary			
Melanoma	0	1	
Non-appendiceal - Gynaecological			
Endometriosis	3	8[b]	
Pelvic inflammatory disease	4	4	
Tubo-ovarian mass[c]	1	1	
Non-appendiceal – Other			
Large bowel diverticulitis	1	1	
Crohn's disease	2	1	
Enterobius vermicularis infection	2	6	
Total important incidental pathology (patients)	**25/465 (5.4%)**	**55/749 (7.3%)**	n/a
Outcomes			
Patient informed within 3 months	21/25 (84%)	42/55 (76%)	0.44
General practitioner informed within 3 months	21/25 (84%)	39/55 (71%)	0.21
Appropriate management or follow up within 6 months	21/25 (84%)	40/55 (73%)	0.27

ASA: American Society of Anesthesiologists physical status score. ASU: acute surgical unit. n/a: not applicable. SD: standard deviation.

[a] a single p-value applies to the difference between all the ASA or appendicitis grades for the two cohorts.

[b] One ASU patient had both appendiceal histology revealing both a low grade mucinous neoplasm and endometriosis.

[c] includes hydro-salpinx, ectopic pregnancy, suspected ovarian mass. Does not include pyosalpinx, which is grouped with pelvic inflammatory disease.

of 55 patients were unsure if their appendix had been removed, and two of twelve patients with important incidental pathology were unsure of their diagnosis. These findings highlight the potential for improvement in all of clinician communication, consult recording and patient information retention.

Incidental detection of important pathology behoves appropriate management. However, very few appendicectomy series confirm that this occurred [6,7,15,26–28]. Safety net systems to ensure patients receive adequate care necessarily differ depending on the timing of detection. Macroscopic pathology detected intra-operatively relies on the punctual post-operative action of the scrubbed registrar and consultant. Microscopic pathology, on the other hand, takes several days to process and so requires a different approach. Options for capture include assigning the responsibility for pathology checking to the involved proceduralists, a single catch-all surgical staff member, the outpatient clinic, an automated letter-to-patient from the histology laboratory [39] or a combination of the above. Macro- or microscopic, strong and robust measures are necessary to ensure incidental pathology is not missed. The rates of appropriate management observed in this study were lower than expected. This study has subsequently prompted our department to re-emphasise the importance of each staff member regular reviewing and acting on pathology results.

Adequate communication with a patient's general practitioner is essential for patient care. It provides a safety net if patients fail to pursue recommended management, reduces double treatment if they are unclear this has already occurred and empowers the GP as the coordinator of the patient's care [40]. Increased collaboration with GPs has been associated with positive outcomes in a wide range of conditions, including cancer care and medication-related unplanned hospital admission [41,42]. However, no studies to date have described GP communication rates following appendicectomy. Post-operatively, every GP should receive a discharge summary, and also later an outpatient letter for those patients reviewed in clinic. General practitioners place a high value on promptly receiving discharge summaries, including following general surgery [43]. However, disseminating a summary shortly after discharge means histopathology results will not be available for many patients. This was indeed the case in this study. The responsibility, therefore, lies on either the conscientious checking of the proceduralist some days post-operatively, as above, or the inpatient team to book an outpatient appointment. Future additional failsafes could include routine dissemination of pathology to GPs, separate to the discharge summary.

The observed rate of significant incidental pathology was generally similar to other large series of > 1,000 patients [6–8,10–22,24,25] (Table 4). Two notable variants in our cohort from the literature were our relatively high rate of benign adenomas of any type, at 2.0% (literature pooled mean 0.2%). However, most studies reported only a single type of adenoma (either tubular, villous or sessile serrated), which when construed to represent the pooled rate of all adenomas would tend to underestimate the true rate. Yuyucu Karabulut et al.'s study of 960 appendicectomies included a comprehensive range of adenomas, with a pooled adenoma incidence of 7.4% [23]. Endometriosis was also more common in our study than expected from the literature. Endometriosis incidence is known to vary considerably both between different nations, and different populations within the same nation. Risk factors for endometriosis include early age of menarche, being of reproductive age, nulliparity and short heavy menstrual cycles [44,45]. Our retrospective cohort may have sampled from a more at-risk population. Indeed, South Australia has been reported as having a > 2x higher prevalence of endometriosis than other Australian states [46]. Alternatively, it has been suggested that endometriosis incidence is overestimated amongst reproductive age women hospitalised for abdominal pain [44]. As five of our cohort's eleven cases of endometriosis were macroscopic diagnoses unsupported by histology, such bias may be present.

This study is limited by its retrospective nature and the relatively small number of patients with important incidental pathology. While the cohorts were superficially demographically statistically similar, there may have been unmeasured differences between the two periods in patient socioeconomic status, ethnicity and comorbidity which affected the incidence of pathology. Enrolment utilised electronic medical records data, which may have been incorrectly coded. This reliance was reduced by manual examination of the medical records of > 1% of the total cohort 1,214 patients, and of every hard copy record for the 80 patients with incidental findings data. Additionally, enrolling patients based on MBS codes means that this study did not capture procedures which commenced with the intention to perform appendicectomy, but

Table 3
Incidental pathology during appendicectomy in series of > 1,000 patients.

	This cohort incidence (overall)	Literature incidence (mean[a],[b], N/D)	Range[b] (min-max %)	Contributing studies
Appendiceal neoplasms - Primary				
Epithelial				
Benign - Any	2.0%	0.2% (66/26,522)	0.06–0.6%	7 [10, 12–14, 19, 21, 25]
Malignant				
LG mucinous neoplasm	0.6%	0.3% (181/56,962)	0.03–0.9%	10 [6–8, 11–14, 16, 19, 20]
HG/adenocarcinoma	–	0.1% (53/58,392)	0.03–0.2%	10 [8, 10–14, 16, 19, 21, 25]
Non-epithelial				
Neuro-endocrine tumours	1.2%	0.4% (299/67,530)	0.09–1.0%	14 [6, 8, 10–16, 19, 20, 22, 24, 25]
Appendiceal neoplasms - Secondary				
Any	0.1%	0.05% (17/36,819)	0.00–0.2%	4 [12, 13, 17, 19]
Non-appendiceal - Gynaecological				
Endometriosis	0.9%	0.1% (32/37,425)	0.01–0.3%	6 [6, 12, 14–16, 18]
Pelvic inflammatory disease	0.7%	1.7% (21/1,232)	1.7%[c]	1 [17]
Tubo-ovarian mass[d]	0.2%	0.1% (3/3,755)	0.04–0.2%	2 [11, 15]
Non-appendiceal – Other				
Cholecystitis	–	0.2% (3/1,255)	0.2%[c]	1 [15]
Enterobius vermicularis infection	0.7%	4.1% (1,889/46,598)	0.04–6.5%	8 [6–8, 10, 14–16, 20]
Foreign body bowel perforation	–	0.04% (2/4,4,95)	0.03–0.1%	2 [10, 13]
Inflammatory bowel disease	0.2%	0.1% (45/53,458)	0.05–0.2%	4 [6, 10, 16, 17]
Large bowel diverticulitis	0.2%	0.8% (59/7,155)	0.1–1.6%	3 [10, 12, 13]
Large bowel malignancy[e]	–	0.1% (2/2,660)	0.1%[c]	1 [12]
Lymphoma	–	0.1% (11/12,896)	0.01–0.3%	3 [6, 7, 19]
Meckel's diverticulitis	–	0.2% (9/4,152)	0.13–0.3%	2 [12, 13]
Peptic ulcer disease	–	0.1% (2/1,492)	0.1%[c]	1 [13]
Schistosomiasis infection	–	0.9% (48/5,344)	0.15–1.3%	2 [6, 20]
M. tuberculosis infection	–	0.2% (3/1,232)	0.2%[c]	1 [17]

D: denominator, summating series reporting at least 1 case of the relevant pathology. HG: high grade. LG: low grade. N: numerator, representing total number of patients with the relevant pathology. %: percentage. -: no cases.

[a] Pooled mean.

[b] Amongst series reporting at least 1 case.

[c] Only a single series of > 1,000 appendicectomies identified reporting this pathology.

[d] includes hydro-salpinx, ectopic pregnancy, suspected ovarian mass. Does not include pyosalpinx, which is grouped with pelvic inflammatory disease.

[e] Not involving appendix.

then changed intra-operatively due to incidental pathology to a different procedure such as hemicolectomy, small bowel resection or salpingo-oophorectomy. Separately, greater than 20% of patient records were not included due to incomplete data, which may bias the results. However, the exclusion was balanced between the Traditional and ASU groups and caused minimal change in group sizes relative to each other. The authors have previously reported satisfactory use of this practice [1,33]. Lastly, it is possible that for some patients, communication did indeed occur, but only verbally, or via posted documentation but without a separate copy being filed in the hard copy case notes. This may have reduced the observed rate of communication to the patient and GP.

5. Conclusion

Introduction of an ASU model did not change documented rates of surgeon-to-patient nor surgeon-to-GP communication nor affect rates of appropriate management of important incidental pathology during appendicectomy.

Data statement

The authors do not have permission from the local health network nor the research ethics committee to make this confidential patient data available for external access.

Provenance and peer review

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CRediT authorship contribution statement

Ned Kinnear: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Writing - original draft, Writing - review & editing. **Bridget Heijkoop:** Data curation, Project administration, Writing - original draft. **Eliza Bramwell:** Data curation, Project administration, Writing - original draft. **Alannah Frazzetto:** Data curation, Project administration, Writing - original draft. **Amy Noll:** Data curation, Project administration, Writing - original draft. **Prajay Patel:** Data curation, Project administration, Writing - original draft. **Derek Hennessey:** Conceptualization, Methodology, Writing - review & editing. **Greg Otto:** Methodology, Supervision, Writing - review & editing. **Christopher Dobbins:** Conceptualization, Methodology, Supervision, Writing - review & editing. **Tarik Sammour:** Conceptualization, Methodology, Supervision, Writing - review & editing. **James Moore:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing - review & editing.

Declaration of competing interest

None to declare.

Please refer to Author Disclosure Statement for details on Ethics, Funding, Study Registration, Acknowledgements and Author

Table 4
Incidental pathology patients without appropriate management.

Condition	Pathological characteristics of incidental pathology
Appendiceal neoplasms - Primary	
Sessile serrated adenomas	
Patient 1 22yo female	NPA, MANA. No dysplasia identified. Completely excised.
Patient 2 25yo female	NPA, MAA. No dysplasia identified. Completely excised.
Patient 3 53yo female	NPA, MAA. No dysplasia identified. Completely excised.
Patient 4 65yo male	NPA, MAA. No dysplasia identified. Completely excised.
Patient 5 70yo male	NPA, MAA. Low grade dysplasia. Completely excised.
Low grade tubular adenoma	
Patient 6 29yo female	NPA, MAA. Microscopic LG TA with low grade dysplasia, completely excised.
Patient 7 68yo female	NPA, MANA. Microscopic LG TA without dysplasia, completely excised.
Low grade mucinous neoplasm	
Patient 8 63yo male	NPA, MAA. A low grade mucinous neoplasm is seen with dissecting acellular mucin in the muscularis propria and meso-appendix. The serosal surface and resection margin are not involved.
Neuro-endocrine tumours	
Patient 9 22yo male	NPA, MAA. 6 mm well differentiated NET, extending through muscularis, but serosa not breached. Meso-appendix and surgical margin are not involved. LVI, mitotic index and Ki-67 index are not reported.
Patient 10 22yo female	NPA, MANA. 3 mm well differentiated NET, confined to the lamina propria. Surgical margin is not involved. Ki-67 index is low (< 2%). LVI and mitotic index are not reported.
Patient 11 27yo male	NPA, MANA. 7 mm well differentiated NET, extending through muscularis, but serosa not breached. Meso-appendix and surgical margin are not involved. No evidence of LVI. Both mitotic index (≤2 mitoses per mm^2) and Ki-67 (< 2%) index are low.
Non-appendiceal – Gynaecological	
Endometriosis	
Patient 12 21yo female	Not applicable – macroscopic diagnosis intra-operatively, no biopsy taken.
Patient 13 35yo female	NPA, MAA. Several foci of endometriosis are seen.
Patient 14 41yo female	NPA, MAA. One focus of endometriosis is seen.
Patient 15 68yo female	NPA, MAA. Several foci of endometriosis are seen.
Non-appendiceal – Other	
Crohn's disease	
Patient 16 19yo male	Not applicable – macroscopic diagnosis intra-operatively, no biopsy taken.
Enterobius vermicularis infection	
Patient 17 20yo female	NPA, MAA. Organisms are seen consistent with *Enterobius vermicularis*.
Patient 18 21yo male	NPA, MAA. Organisms are seen consistent with *Enterobius vermicularis*.
Patient 19 30yo female	NPA, MAA. Organisms are seen consistent with *Enterobius vermicularis*.
Patient 20 52yo female	NPA, MAA. Organisms are seen consistent with *Enterobius vermicularis*.

LG TA: low grade tubular adenoma. LVI: lympho-vascular invasion. MAA: meso-appendix attached. MANA: meso-appendix not attached. NET: neuro-endocrine tumour. NPA: non-perforated appendix. yo: year old.

Contribution.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijsu.2019.10.025.

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