

# Clinical Audit: Computed Tomography in Patients Presenting to the Emergency Department with Diarrhoea—How Often Does Imaging Change Management?

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## Abstract

**Introduction:** Abdominal pain and diarrhoea are amongst the top ten presentations to emergency departments in Australia. There is limited guidance on use of abdominal and pelvic computed tomography (CTAP) imaging in these patients. CTAP imaging has benefits including revealing potential diagnoses. However, there are numerous risks including radiation, cost and time.

**Aim:** The aim of this retrospective audit is to assess how often CTAP imaging in patients presenting with diarrhoea leads to major change in management, identified as an intervention that would otherwise have not occurred without the scan.

**Methods:** A retrospective audit of 154 CTAPs was performed, in adult patients presenting to a tertiary ED with diarrhoea, over 6 months.

**Results:** 107 (69.5%) had no major change in management. 47 (30.5%) scans led to a major change in management. Patients with normal white cell count, normocardia, normothermia, and absence of thrombocytopenia were more likely to have CTAP results that do not lead to major change in management.

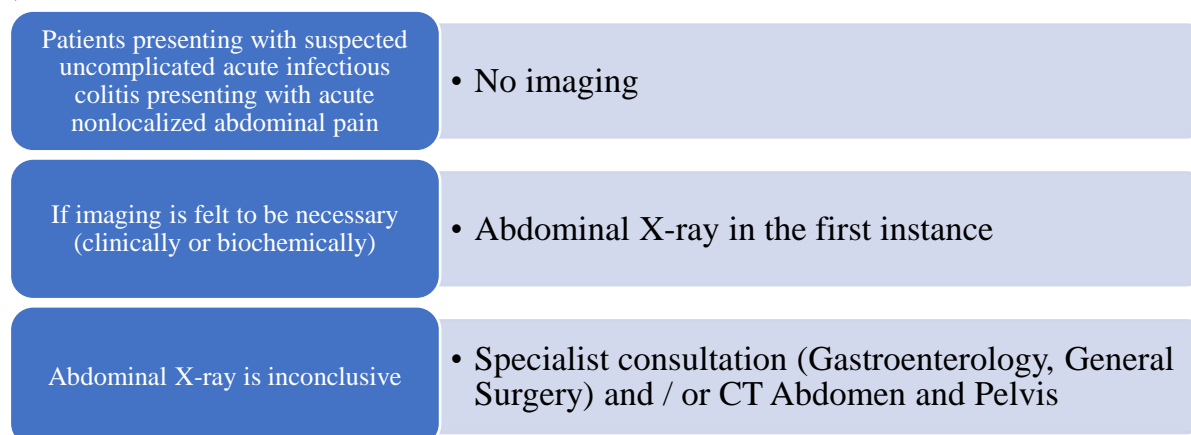
**Conclusion:** Overall, abdominal CT imaging may not always significantly change management in patients presenting to ED with diarrhoea. CT scanning of the abdomen and pelvis has numerous risks and benefits and in patients presenting to ED with

## Background

Abdominal pain and diarrhoea are amongst the top ten presentations to emergency departments in Australia.<sup>1</sup> There can be a broad differential diagnosis and the cost to the healthcare system can be significant, for example the estimated cost of acute viral gastroenteritis is over \$350 million per year.<sup>2</sup> Assessment of patients presenting with diarrhoea and abdominal

pain involves clinical, laboratory and occasionally radiological investigation. The role of computed tomography (CT) in non-traumatic abdominal pain is well established across numerous guidelines. However, there is limited guidance regarding the role of abdominal CT imaging in patients presenting with diarrhoea.

The Canadian Association of Radiologists Gastrointestinal Imaging Referral (CARGIR) guideline recommends the following (Figure 1)<sup>3</sup>:



**Figure 1:** CARGIR guidelines and imaging recommendations

Benefits of CT abdomen and pelvis (CTAP) imaging include identifying diagnoses. Normal CT results may provide reassurance to clinicians and patients in cases of diagnostic uncertainty. However, there are risks, including radiation effects, contrast risks, cost and time. One CT abdomen and

pelvis is equivalent in radiation to 50 abdominal plain films and nearly three years of natural background radiation exposure<sup>4,5</sup>. The estimated Medicare cost of one CT abdomen and pelvis is \$597<sup>6</sup>. CT scanning is also associated with a period of waiting time, depending on local factors such as availability of scanners,

volume of studies requested and staff capacity to review scans. Some studies demonstrated a median emergency department (ED) stay of over nine hours in patients receiving a CT abdomen and pelvis<sup>7</sup>. Severe reactions (anaphylactic shock or cardiac arrest) to iodinated contrast are rare at 1 in 100,000 patients but can be fatal<sup>8</sup>.

Therefore, in patients presenting with diarrhoea it is important to rationalise the use of CT abdomen and pelvis imaging and weigh risks and benefits.

**Ethics Statement**

Approval to conduct this audit was obtained from the hospital research ethics committee with the assigned reference code HREC/2024/QGC/109631. No funding was obtained for this audit.

**Aim**

The aim of this audit is to understand if the use of CTAP resulted in major change in management in patients presenting to the ED with diarrhoea.

**Definitions**

Diarrhoea was defined as passage of three or more loose stools per day (type five to seven on Bristol stool chart).<sup>9,10</sup> A major change in management was defined as an intervention that would not have occurred without the CTAP. For example, when bowel mass was suspected and CT demonstrated colonic neoplasm, the patient received relevant surgical intervention.

**Methods**

Patients presenting to our tertiary hospital ED with diarrhoea who received abdominal or pelvic CT imaging, over the last 6 months, were reviewed. Each patient’s medical record was

reviewed by one author (KD). Patients were selected according to inclusion and exclusion criteria.

Data was recorded using a standardised format in Microsoft Excel and patient information was de-identified for confidentiality.

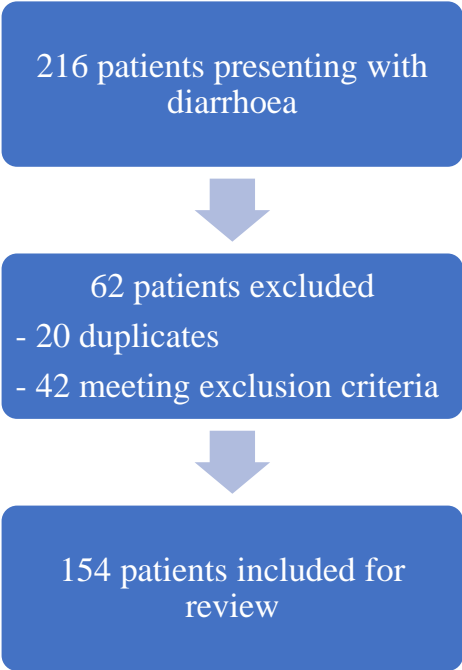
The following patient parameters were recorded: age, sex, patient origin, primary presenting complaint, duration of diarrhoea, presence of mucus in stool, presence of blood in stool, weight loss, travel history, peripheral pulse rate, temperature, final diagnoses, if endoscopy was performed, if surgery was performed, if any other interventions were performed, patient disposition and overall if CT resulted in major change in management.

The following laboratory parameters were recorded: haemoglobin, white cell count, platelets, c-reactive protein (CRP), lactate, stool study results.

The following radiological parameters were recorded: CT protocol, requesting department, radiological diagnoses and incidental findings.

Inclusion criteria were adults aged over 18 years old, non-pregnant, presenting to ED with diarrhoea, presenting within the last 6 months and received abdominal CT imaging.

Exclusion criteria were patients aged under 18 years old, pregnant patients, non-ED presentations and patients receiving non-CT abdominal imaging 216 patients were initially obtained for review. Duplicates and patients meeting exclusion criteria were removed. 154 patients were included for review (Figure 2: selection of patients).



**Figure 2:** Selection of patients.

**Results**

154 patients presenting with diarrhoea received abdominal CT imaging. The median age was 56.5 years. 93 (60.3%) were female. 61 (39.6%) were male. The most common ethnic demographic was Caucasian. The median duration of diarrheal symptoms was three days. The majority of scans were ordered by ED (102), followed by General Surgery (5) and then

Gastroenterology, Palliative Care, and Nephrology units (1 each). The most common CT protocol was CT abdomen and pelvis with portal venous phase contrast (Table 1: Patient demographics and CT scan characteristics). 107 (69.5%) had no major change in management. 47 (30.5%) scans led to a major change in management.

**Table 1:** Patient and CT scan characteristics.

Patient characteristics	N (%)
Total	154 (100)
Median Age	56.5 years
Male	61 (39.6)
Female	93 (60.4)
Patient origin	
• Australasian	132 (85.7)
• North Asian	1 (0.65)
• South East Asian	4 (2.6)
• African	3 (1.94)
• South American	1 (0.65)
• European	11 (7.14)
• Middle Eastern	1 (0.65)
CT scan characteristics	
• Abdomen + Pelvis + Contrast (portal venous)	145 (94.1)
• Abdomen + Pelvis + Contrast (multiphase)	5 (3.24)
• Chest + Abdomen + Pelvis + Contrast (portal venous)	2 (1.29)
• Abdomen + Pelvis + Contrast (portal venous)	1 (0.65)
• Abdomen + Pelvis (non-contrast)	1 (0.65)
Ordering department	
• Emergency	102 (66.2)
• General Surgery	5 (3.25)
• Gastroenterology	1 (0.65)
• Palliative Care	1 (0.65)
• Nephrology	1 (0.65)

Of the 107 scans that resulted in no major change in management, the most common radiological results were a normal scan (42 results, 39.3%) and colitis (26 results, 24.3%). The most common clinical diagnoses across the scans that had no major change in management were unspecified abdominal pain (22 diagnoses, 20.1%), unspecified diarrhoea (12 diagnoses, 11.2%) and acute viral gastroenteritis (12 diagnoses, 11.2%) (Appendix Table 3.0: Radiological findings and Clinical Diagnoses).

Two patients had mucus in the stool. Seventeen patients had blood in stool. Seven had weight loss. Two had international travel and two had local travel. The majority of patients (88, 82.2%) were normocadic (peripheral pulse rate <100). The majority of patients (98, 91.5%) were afebrile (≤37.8°C).

The majority of patients (66, 63.5%) had a normal white cell count (≤11 x 10<sup>9</sup>/L). The majority of patients (97, 93.3%) did not have thrombocytosis (platelet count <400 x 10<sup>9</sup>/L). Regarding CRP level, the majority (73, 68.2%) had elevated results over 0.5mg/dL. Sixteen patients had positive stool cultures (most commonly Campylobacter species). (Table 2: Characteristics of patients with CT scans with and without major change in management).

Fifty-nine patients were discharged (one against medical advice). Forty-eight patients were admitted, most commonly for observation and or intravenous antibiotics. Two patients received endoscopy (one patient was transferred to a different centre, for procedural endoscopy to insert a nasojejunal tube. One diagnostic gastroscopy was performed demonstrating gastritis). Zero patients received surgery and zero patients received other intervention (Appendix Table 3.1 Patient dispositions).

Of the 47 scans that resulted in major change in management, the most common radiological results were acute appendicitis (10 results, 21.2%) and diverticulitis (15 results, 31.9%). These were also the most common clinical diagnoses (Table 3: Outcomes of scans that did not result in major change in management) (Appendix Table 3.0: Radiological findings and Clinical Diagnoses).

Two patients had mucus in the stool. Eight patients had blood in the stool. Seven denied any travel. The majority of patients (35, 74.4%) were normocadic (peripheral pulse rate <100). The majority of patients (39, 82.9%) were afebrile (≤37.8°C).

However, the majority of patients (29, 61.7%) had an elevated white cell count ( $>11 \times 10^9/L$ ). The majority of patients also had elevated CRP (39, 82.9%). Only three patients had thrombocytosis (platelet count  $<400 \times 10^9/L$ ). Ten patients had stool cultures performed which were negative. (Table 2: Characteristics of patients with CT scans with and without major change in management).

Two patients were discharged (one transferred to a private hospital). Forty-five patients were admitted of which nine received endoscopy and 14 received surgery. The other most common reasons for admission were intravenous antibiotics (14) and conservative management of bowel obstruction (4) (Appendix Table 3.1 Patient dispositions).

**Table 2:** Characteristics of patients with CT scans with and without major change in management.

	CT scans with <b>major change in management</b> (N = 47)	CT scans with <b>no major change in management</b> (N = 107)
Median duration diarrhoea (days)	3	3
Mucus in stool	<ul style="list-style-type: none"> <li>7 negative</li> <li>37 not assessed</li> <li>2 positive</li> </ul>	<ul style="list-style-type: none"> <li>10 negative</li> <li>95 not assessed</li> <li>2 positive</li> </ul>
Blood in stool	<ul style="list-style-type: none"> <li>22 negative</li> <li>17 not assessed</li> <li>8 positive</li> </ul>	<ul style="list-style-type: none"> <li>46 negative</li> <li>44 not assessed,</li> <li>17 positive</li> </ul>
Weight loss	<ul style="list-style-type: none"> <li>2 weight loss</li> <li>40 not assessed</li> <li>5 no weight loss</li> </ul>	<ul style="list-style-type: none"> <li>7 weight loss</li> <li>94 not assessed</li> <li>6 no weight loss</li> </ul>
Travel	<ul style="list-style-type: none"> <li>7 no travel</li> <li>40 not assessed</li> </ul>	<ul style="list-style-type: none"> <li>2 international</li> <li>2 local</li> <li>93 not assessed</li> <li>10 no travel</li> </ul>
Tachycardia (peripheral pulse rate $>100$ )	<ul style="list-style-type: none"> <li>12 tachycardic</li> <li>35 normocardic</li> </ul>	<ul style="list-style-type: none"> <li>88 tachycardic</li> <li>19 normocardic</li> </ul>
Fever (temperature $>37.8^\circ C$ )	<ul style="list-style-type: none"> <li>8 febrile</li> <li>39 afebrile</li> </ul>	<ul style="list-style-type: none"> <li>9 febrile</li> <li>98 afebrile</li> </ul>
Median Hb and Anaemia (Hb $<70$ )	<ul style="list-style-type: none"> <li>129g/L</li> <li>0 with Hb <math>&lt;70g/L</math></li> </ul>	<ul style="list-style-type: none"> <li>135g/L</li> <li>0 with Hb <math>&lt;70g/L</math></li> </ul>
Elevated white cell count ( $>11 \times 10^9/L$ )	<ul style="list-style-type: none"> <li>28 elevated WCC</li> <li>19 normal WCC</li> </ul>	<ul style="list-style-type: none"> <li>41 elevated WCC</li> <li>66 normal WCC</li> </ul>
Elevated platelets ( $>400 \times 10^9/L$ )	<ul style="list-style-type: none"> <li>44 thrombocytosis</li> <li>3 without thrombocytosis</li> </ul>	<ul style="list-style-type: none"> <li>10 thrombocytosis</li> <li>97 without thrombocytosis</li> </ul>
Elevated C-reactive protein ( $>0.5mg/dL$ )	<ul style="list-style-type: none"> <li>39 elevated CRP</li> <li>6 not assessed</li> <li>2 normal CRP</li> </ul>	<ul style="list-style-type: none"> <li>73 elevated CRP</li> <li>28 not assessed</li> <li>12 normal CRP</li> </ul>
Elevated lactate ( $>2.0mmol/L$ )	<ul style="list-style-type: none"> <li>9 elevated lactate</li> <li>26 not assessed</li> <li>12 normal</li> </ul>	<ul style="list-style-type: none"> <li>18 elevated lactate</li> <li>51 not assessed</li> <li>38 elevated lactate</li> </ul>
Stool study	<ul style="list-style-type: none"> <li>10 negative</li> <li>37 not assessed</li> </ul>	<ul style="list-style-type: none"> <li>4 Salmonella positive</li> <li>7 Campylobacter positive</li> <li>2 Clostridium difficile positive</li> <li>1 Cryptosporidium positive</li> <li>1 Norovirus positive</li> <li>1 Shigella positive</li> <li>70 not assessed</li> <li>20 negative</li> </ul>

### Incidental Findings

Across 154 CT scans, 133 scans (86.3%) had at-least one incidental finding. The most common benign findings included: simple renal cysts, cholelithiasis, hepatic steatosis, non-incarcerated hernias, and simple hepatic cysts. Significant incidental findings were also identified, including lung and

breast nodules. Two scans had a major change in management only due to malignant incidental findings. One demonstrated renal cell carcinoma. The second demonstrated common bile duct stricturing which was found to be cholangiocarcinoma (Table 3: Incidental findings).

**Table 3:** Incidental findings

Benign (number of events)		Significant (number of events)	
Aortic calcifications	5	Adrenal lesions	4
Cholelithiasis	11	Breast lesions	4
Diverticulosis	7	Common bile duct stricturing	1
Faecaloma	1	Hepatic lesions	3
Foreign body	1	Liver lesions	5
Hepatic cysts (simple)	2	Lung nodules	7
Hepatic steatosis	21	Oesophageal nodules	1
Hernias	23	Perirectal lesions	1
Hydronephrosis	2	Pulmonary embolism	1
Intussusception	1	Renal lesions	1
Liver cysts (simple)	15		
Liver haemangioma	1		
Lung fibrosis	1		
Lung ground glass changes	3		
Lymphadenopathy	4		
Omental infarct	1		
Ovarian cysts	7		
Pancreatic calcifications	4		
Pancreatic cysts	2		
Prostatomegaly	1		
Renal calculi	4		
Renal cysts	25		
Splenic cysts	2		
Splenomegaly	2		
Spondylolisthesis	2		
Uterine fibroids	1		
Vertebral fracture	1		

## Discussion

Overall, abdominal CT imaging did not always change in management in patients presenting to ED with diarrhoea. Most of these patient's scans were normal or demonstrated colitis of non-specific aetiology. Amongst this group, most patients demonstrated no tachycardia, were afebrile, had normal white cell count and absence of thrombocytopenia (an inflammatory marker).<sup>10</sup> In patients with these parameters, the scan may be less likely to have major change in management outcomes. Most patients were discharged. Of the 48 admissions, 10 were for observation and 15 for empiric intravenous antibiotics, due to a suspected diagnosis of infectious colitis. However, 20 stool studies were negative and 70 out of 107 patients had no stool testing performed to confirm or exclude this diagnosis. Sixteen scans may have been avoidable in those patients who had confirmed positive stool cultures, identifying infectious colitis. Overall, whilst it is important to be vigilant for life-threatening diagnoses, it may also be valuable to consider common diagnoses thorough investigation with simple laboratory tests such as stool studies.

Amongst the group of patients where CT led to major change in management, most patients had an elevated white cell count and CRP. The most common diagnoses included appendicitis and diverticulitis. An elevated white cell count may be a predictor of positive CT findings. Elevated white cell count is already used in various scoring systems, such as the Alvarado Score for acute appendicitis<sup>11</sup>.

Both groups were found to have an elevated CRP. 68.2% of patients had an elevated result in the group that had no major change in management. 82.9% of patients had an elevated result in the group where CT resulted in major change in management. This may be explained due to the fact that CRP is a non-specific marker of inflammation and may be elevated in numerous conditions. Both cohorts had inflammatory diagnoses including colitis, appendicitis and diverticulitis that may contribute to elevated CRPs.<sup>12</sup>

A retrospective study by Aisenburg et al (2013) reviewed 124 scans over a 3-month period of patients presenting with diarrhoea. Only 13 scans (11%) changed management, with the most common diagnoses being appendicitis, diverticulitis and bowel obstruction. Of the remaining 111 scans that did not change management, the most common diagnoses were abdominal pain (73 events) and gastroenteritis (43 events).<sup>13</sup>

Some studies have demonstrated CT scanning may be beneficial in particular patients with diarrhoea. Chen et al (2008) performed secondary analysis of a prospective cohort study of 1000 patients with non-traumatic abdominal pain, of which 174 had diarrhoea. 15 patients required surgical intervention. Using multivariate analysis, two variables demonstrated a sensitivity of 1.0 (95% CI, 0.78-1.0) and specificity of 0.23 (95% CI 0.16-0.30), which were age over 40 and constant pain. These patients may demonstrate abnormal CT results, requiring major intervention.<sup>14</sup> Ullery et al (2009) outline in their literature



review about neutropenic enterocolitis, a spectrum of disease characterized by fever and abdominal pain in the setting of neutropenia (absolute neutrophil count  $< 1,500\text{mm}^3$ ). Clinical diagnosis is often impeded by subtle and non-specific presentations including nausea, vomiting and haematochezia and therefore a high index of suspicion and CT abdominal imaging are considered the linchpin of diagnosis.<sup>15</sup>

CT scanning is not without risks, including radiation exposure, cost and time. Age-related cancer risk has also been associated with repeat CT-scanning of the abdomen and pelvis, including an increased incidence of myelodysplasia, leukemia, soft tissue cancers, brain cancers and all other solid cancers excluding thyroid cancer and melanoma<sup>5</sup>. Incidental findings pose a risk and benefit of CT imaging. A high number of incidental findings were observed in this audit, seen in 86.3% of CTAPs. They may lead to early detection of malignancy, as found in two patients in this audit showing renal carcinoma and cholangiocarcinoma. However, many incidental findings are often benign, but may lead to further imaging and cause patient anxiety<sup>16</sup>.

### Conclusion

Overall, abdominal CT imaging may not always significantly change management in patients presenting to ED with diarrhoea. Patients with normal white cell count, normocardia, normothermia, and absence of thrombocytopenia [space] may be likely to have CT results that do not lead to major change in management. Elevated white cell count may be more commonly associated with CT findings that may lead to major intervention, however CRP remains may be less specific. CT scanning of the abdomen and pelvis has numerous risks and benefits and in patients presenting to ED with diarrhoea comprehensive patient and risk assessment is important.

### Strengths and Limitations

Strengths include a substantial six month period of included patients, substantial number of included scans and high diagnostic accuracy of scan results (all reported by Royal Australia New Zealand Radiology College certified members).

Limitations include: data collection relied upon accuracy and completeness of documentation, retrospective nature of the audit (patients may have developed significant diagnoses, post the CT scans included in this study) and the subjective nature of the definition of major change in management. Lack of intervention may also be considered a major change in management, depending on individual discretion. To attempt to overcome this limitation only one author evaluated patient records and maintained strict inclusion and exclusion criteria.

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## APPENDIX

**Table 4.0:** Radiological findings and Clinical Diagnoses.

Diagnoses in Patients with CT Scans that led to Major Change in Management		Diagnoses in Patients with CT Scans that Did not lead to Major Change in Management	
CT Findings (n)		CT Findings (n)	
Acute appendicitis	8	Acute Pulmonary Oedema	1
Acute Pancreatitis	1	Diverticulitis	2
Acute perforated Appendicitis	2	Colitis	26
Diverticulitis	15	Diverticulosis	8
Colonic mass	2	Pancreatic pseudocyst (resolved)	1
Cholecystitis	1	Enteritis	6
Bowel obstruction	8	Epiploic appendagitis	2
Enteritis	0	Faecal loading	2
Pouchitis	1	Gastritis	1
Colitis	2	Mesenteric panniculitis	1
Diverticulosis	1	Normal	42
UGIB	1	Pancolitis	5
Renal malignancy	1	Proctitis	2
Cholangiocarcinoma	1	Small Bowel Obstruction	2
Hepatic abscess	1	Pancreatic malignancy (stable)	1
Gastric outlet obstruction	1	Stercoral colitis	1
Right kidney pyelonephritis	1	Terminal ileitis	3
Right portal vein thrombosis	1	Anastamotic leak	1
Clinical Diagnoses (n)		Clinical Diagnoses (n)	
Appendicitis	10	Acute Pulmonary Oedema	1
Pancreatitis	1	Abdominal pain (unspecified)	22
CBD stricturing	1	Acute Viral Gastroenteritis	12
Cholecystitis	1	Anastamotic leak	1
Colitis	2	Colitis (unspecified)	26
Colon cancer	2	Clostridium difficile colitis	2
Diarrhoea (unspecified)	1	CMV colitis	1
Diverticlosis	2	Constipation	2
Diverticulitis	15	Diarrhoea (unspecified)	12
Gastric Outlet Obstruction	1	Drug induced liver injury	1
Gastritis	1	Diverticulitis	2
Bowel obstruction	9	Diverticulosis	7
Portal vein thrombus	1	Enteritis	3
Pouchitis	1	Epiploic appendicitis	2
Pyelonephritis	1	Gastritis	1
Hepatic abscess	1	Sepsis	2
Ulcerative Colitis	1	Hyperosmolar hyperglycaemic state	1
		Mesenteric panniculitis	1
		Pelvic pain (unspecified)	1
		Pneumonia	1
		Biliary leak	1
		Proctitis	1
		Stercoral colitis	1
		Small Bowel Obstruction	2
		Upper GI Bleed	1

**Table 4.1:** Patient dispositions

Dispositions in Patients with CT Scans that led to Major Change in Management		Dispositions in Patients with CT Scans that Did Not lead to Major Change in Management	
Admitted		Admitted	
• for hepatic abscess drainage	1	• for removal of peripheral line	1
• for inter-hospital transfer	1	• for monitoring	10
• for flexible sigmoidoscopy	4	• for electrolyte correction	3
• for colonoscopy	1	• for IV Fluids	4
• for gastroscopy	2	• for cellulitis	1
• for Upper gastrointestinal endoscopic ultrasound	1	• for palliation	1
• for small bowel enteroscopy	1	• for delirium	2
• for further investigation	1	• for constipation	2
• for intravenous antibiotics	14	• for non-clinical admission	1
• for bowel obstruction management	4	• to ICU for acute pulmonary oedema (unrelated to CT)	1
• for intravenous fluids	1	• to ICU for blood glucose level management (unrelated to CT)	1
• for surgery	14	• for intravenous antibiotics	15
• for treatment of hepatic thrombus	1	• for endoscopy	2
• Interhospital transfer to private for surgery	1	• for analgesia	1
Discharged (with oral antibiotics)	1	• for chronic liver disease management	1
		• for further Ix	1
		Discharged against medical advice	2
		Discharged home	58

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