

## Intra-Abdominal Infection in Review

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### Abstract

**Background:** Intra-abdominal infection is unique health complication. There is a wide variety of condition incidence ranging from uncomplicated conditions to fulminant septic shock to multi-organ dysfunction. This study was conducted to review results of previous studies regarding intra-abdominal infections.

**Method:** This is a systematic review was carried out, including PubMed, Google Scholar and EBSCO. Topics concerning intra-abdominal infections and abscess and other articles were used in the making of the article. The founded articles were screened by titles and reviewing the abstracts. No software will be utilized to analyze the data. Double revision of each member's outcomes was applied to ensure the validity and minimize the mistakes.

**Results and Conclusion:** The review included 8 randomized studies. Intra-abdominal infection (IAI) is a comprehensive term that covers a number of infectious manners. The essential pragmatic treatment is established by identifying whether the infection is whether healthcare- or community-acquired, which organs are infected and if the infection is complicated or uncomplicated. Anti-microbial resistance is of a huge importance and must be further studied to be well avoided.

**Keywords:** Intra-Abdominal Infection (IAI); Anti-Microbial Resistance; Abdominal Abscess

### Introduction

Intra-abdominal infection (IAI) is a prevalent surgical emergency [1]. Abdominal abscess is as heterogeneous and a complex abscess which has vast systemic consequences of that varies between frank septic shock to nothing at all suppressed by antibiotics [2,3].

Intra-abdominal infection is unique health complication. There is a wide variety of condition incidence ranging from uncomplicated conditions to fulminant septic shock to multi-organ dysfunction. There is also a wide variety of pathogens, including Gram-positive and Gram-negative aerobic bacteria, anaerobic bacteria and fungi [4]. Furthermore, source control encompassing all interventions to eradicate the source of infection, control on-going contamination, and to restore anatomic derangements and physiologic function, is key to clinical management and success, but often difficult to achieve [5]. Finally, there is the wide variety of clinical entities within intra-abdominal infections.

IAI is a comprehensive expression that comprehends a number of infectious processes as peritonitis, diverticulitis, cholecystitis, cholangitis, and pancreatitis [6]. Abdominal abscesses are caused by bacteria that typically penetrate the abdomen as a consequence of pene-

trating trauma, intestinal rupture, or intra-abdominal surgery. Intra-abdominal abscesses may occur when the abdominal cavity or organ in the abdomen is damaged in some way and bacteria are able to reach the abdomen [7]. Abscesses can also form in the space between the abdominal cavity and the spine named retroperitoneal abscesses [8].

The organism blamed for the IAI may be assumed on the basis of the site of the organ that was initially affected, as the native GI flora is usually responsible for the IAI [9]. Primary abscesses such as the psoas one are often mono-bacterial, with the Staphylococci predominantly while postoperative abscesses are often characterized by the flora typical of tertiary peritonitis-representing superinfection with yeasts [10].

Abscesses that are undrained may extend to contiguous structures, disintegrate into adjacent vessels causing hemorrhage or thrombosis, break into the peritoneum or intestine, or form a cutaneous or genitourinary fistula [11].

Diagnosis of IAI with the results of the physical examination along with sepsis factors should be considered. Serum lactic acid, arterial blood gases and oxygen saturation levels are typically measured, particularly where sepsis is suspected. In addition, X-ray images using oral and IV contrast CT scans can also be helpful for the depiction of the abdominal cavity [12].

Antibiotics are not efficacious but can reduce hematogenous distribution and should be administered before and after intervention. Therapy requires IV medicines that are active against intestinal flora. Patients of community-acquired infection must be characterized as having a moderate to high risk of treatment failure or death due to symptoms of sepsis or septic shock, age extremes, comorbidity, degree of intestinal infection, and risk of antibiotic resistance [13].

Although most intra-abdominal abscesses demand drainage, by either percutaneous catheters or by surgery; exceptions include small (< 2 cm) pericolic or periappendiceal abscesses or abscesses which spontaneously drain into the skin or the intestine [14]. Open abdominal surgery is a daunting task that can be difficult due to adhesions and lack of adequate anatomical routes to separate the intestines [15].

This study was conducted to review results of previous studies regarding intra-abdominal infections.

## Materials and Methods

### Sample and study groups

PubMed and EBSCO Information Services were chosen as the search databases for the publications used within the study, as they are high-quality sources. PubMed being one of the largest digital libraries on the internet developed by the National Center for Biotechnology Information (NCBI) which is a part of the United States National Library of Medicine. Topics concerning intra-abdominal infections and abscess and other articles were used in the making of the article. The founded articles were screened by titles, and reviewing the abstracts.

**Inclusion criteria:** The articles were selected based on the relevance to the project which should include one of the following topics: 'intra-abdominal infection, intra-abdominal abscess, epidemiology of intra-abdominal infection, surgical management of intra-abdominal abscess'.

**Exclusion criteria:** All other articles which do not have one of these topics as their primary end, or repeated studies, and reviews studies were excluded.

### Statistical analysis

No software will be utilized to analyze the data. The data was extracted based on specific form that contains (Title of the publication, author's name, objective, summary, results and outcomes). Double revision of each member's outcomes was applied to ensure the validity and minimize the mistakes.

During articles selection, studies were doubled-reviewed, and their results to assure that we enroll the studies related to the objective of our study, and to avoid or minimize errors in the results.

**Results**

The search of the mentioned databases returned a total of 105 studies that were included for title screening. 63 of them were included for abstract screening, which lead to the exclusion of 32 articles. The remaining 31 publications full-texts were reviewed. The full-text revision lead to the exclusion of 23 studies, and 8 were enrolled for final data extraction (Table 1).

Author, Country, Publishing Year	Objective and Methodology	Results and Conclusion
Blot S, Antonelli M, Arvaniti K, <i>et al.</i> (2019). [16]	A multicenter observational, epidemiological study included 309 adult ICU patients diagnosed with intra-abdominal infection to describe the epidemiology of intra-abdominal infection.	Infection was community-acquired in 31.6%, early onset hospital-acquired in 25%, and late-onset hospital-acquired in 43.4% of patients. Antimicrobial resistance recorded prevalence of 26.3% and Gram-negative bacteria were hard to be treated in 4.3%, with great variation according to geographic region. Setting of infection acquisition did not affect prevalence of antimicrobial resistance. Mortality rate was found to be 29.1% with included late-onset hospital-acquired infection, diffuse peritonitis, sepsis, septic shock, older age, malnutrition, liver failure, congestive heart failure, antimicrobial resistance and source control failure evidenced by either the need for surgical revision or persistent inflammation as independent risk factors for mortality.
Sartelli, M., Catena, F., Ansaloni, L., <i>et al.</i> (2013). [17]	A multicenter observational prospective study included 57 medical institutions worldwide on patients undergoing surgery or interventional drainage to address complicated intra-abdominal infections to describe the epidemiological, clinical, microbiological, and treatment profiles of both community-acquired and healthcare-acquired complicated intra-abdominal infections.	Authors found that; (87.6%) of participants had community-acquired IAIs, (12.4%) suffered from healthcare-associated infections. Generalized peritonitis was recorded in (43.3%), whereas localized peritonitis or abscesses was registered in (57.7%) patients. The overall mortality rate was 10.1% (71/702).
Avkan-Oguz V., <i>et al.</i> [18]	Hospital based study included 81 patients with positive cultures from three hospitals to survey the local microbiological data and antimicrobial susceptibilities of the isolates obtained from C-clAI	Diagnosis for admission was reported by authors as; acute appendicular infection in 42.1%, intra-abdominal abscess (17.3%), cholecystitis in (18.5%) and tumor resection in (14.8%). (33.3%) cultures were polymicrobial. The most common gram-negative pathogens were <i>E. coli</i> (76.5%), <i>P. aeruginosa</i> (16%) and <i>Klebsiella</i> sp (11.1%). The gram-positive pathogens were <i>Enterococcus</i> sp (13.6%) and <i>Streptococcus</i> sp (7.4%). ESBL (9.9% in <i>E.coli</i> , 1.2 % in <i>Klebsiella</i> sp) and IBL(in <i>P. aeruginosa</i> , <i>Citrobacter</i> sp, <i>Morganella morganii</i> , <i>Enterobacter</i> sp) production were detected in 10(12.3%) and 18(22.2%) isolates, respectively.

Blot S., <i>et al.</i> (2019) [19]	An observational epidemiological study on 2621 critically ill adults with intra-abdominal infections at 309 international centers between January and December 2016.	The study results indicated that; 32% were community-acquired, while 68% were hospital-acquired. Secondary peritonitis composed 68% of cases, followed by biliary tract infections, intra-abdominal abscesses, and peripancreatic infections (12%, 7%, and 6%, respectively). Surgical source control was employed in 96% of patients; a second intervention became necessary in 16%. Death occurred in 24%, 27%, and 34% of patients with community-acquired, early-onset, and late-onset hospital-acquired intra-abdominal infections, respectively.
Newman, Nitza., <i>et al.</i> (2009) [20]	Hospital based observational study undertaken to investigate the epidemiologic, clinical, microbiologic and therapeutic characteristics of community-acquired complicated intra-abdominal infections occurring in children	Results indicate that; (92%) had complicated acute appendicitis (10% of them underwent computerized tomography-guided percutaneous drainage of peri-appendicular abscesses). Aerobes were isolated in 86% of cases and anaerobes in 14%. <i>Escherichia coli</i> was the most common pathogen 57%. Post-operative complications were recorded in (27%) patients.
Cinat ME., <i>et al.</i> (2002) [21]	A multicenter prospective study included patients who had intra-abdominal infections treated with PCD and intravenous antibiotics.	Postoperative abscess reported in 53% of patients. <i>Bacteroides</i> species (17%), <i>Escherichia coli</i> (17%), <i>Streptococcus</i> species (14%), <i>Enterococcus</i> species (10%), and fungi (11%) were the isolated organisms. Single abscesses were present in 83% of patients. Computed tomographic guidance was used for drainage in 80% of patients, and ultrasound was used in 20%.
Chih-Hsien Lo., <i>et al.</i> (2008) [22]	A hospital based study included 2,076 patients with gastric cancer underwent extended risk factors and management for intra-abdominal infection after extended radical gastrectomy.	(3.9%) patients were found to have intra-abdominal infections. Age, prolonged operation time, and combined organ resection were the precipitating factors. Intra-abdominal abscess with adequate drainage, intra-abdominal abscess without anastomotic leakage, and intra-abdominal abscess because of leakage were subtypes of infections. Mortality rate was 22.5%, and the most common cause of mortality was intra-abdominal abscess caused by leakage.
Kumar, R.R., Kim, J.T., Haukoos, J.S., <i>et al.</i> (2006) [23]	A retrospective chart review of 114 patients with intra-abdominal abscesses to evaluate the use of antibiotic therapy and percutaneous image-guided drainage in adult patients with intra-abdominal abscesses.	(59%) had intra-abdominal abscesses due to appendicitis, (3%) lacked conservative management and had emergency surgery. (54%) patients recovered on with intravenous antibiotic treatment.

**Table 1:** Author, country, year of publication, methodology and results.

Blot S., Antonelli M., Arvaniti K., *et al.* reported that; there are disease-specific phenotypic features as environment of infection formation, anatomical impairment, and severity of disease expression which are correlated with the result, regardless of the type of infection. Antimicrobial resistance is similarly widespread in both community-acquired and hospital-acquired infections [16].

Sartelli M., Catena F., Ansaloni L., *et al.* found that; complicated intra-abdominal infections is an important source of morbidity frequently associated with poor clinical prognoses, particularly for patients in high-risk categories [17].

Avkan-Oguz V., *et al.* reported that; 10% or more of gram-negative pathogens in C-clAIs are resistant to common antibiotics. Fluoroquinolones and ceftriaxone resistance was found in 22.2% and 14.5% of *E. coli* isolates, respectively. Pragmatic treatment must be attuned according to the local susceptibility data in C-clAIs [18].

Blot S., *et al.* concluded that; There is a large proportion of multi-resistant infections and a frightening 24 to 34% death rate unchanged from previous studies amid widespread source regulation and over-inclusive” antibiotic therapy. This research also shows little gain from the observational coverage of enterococci or fungi [19].

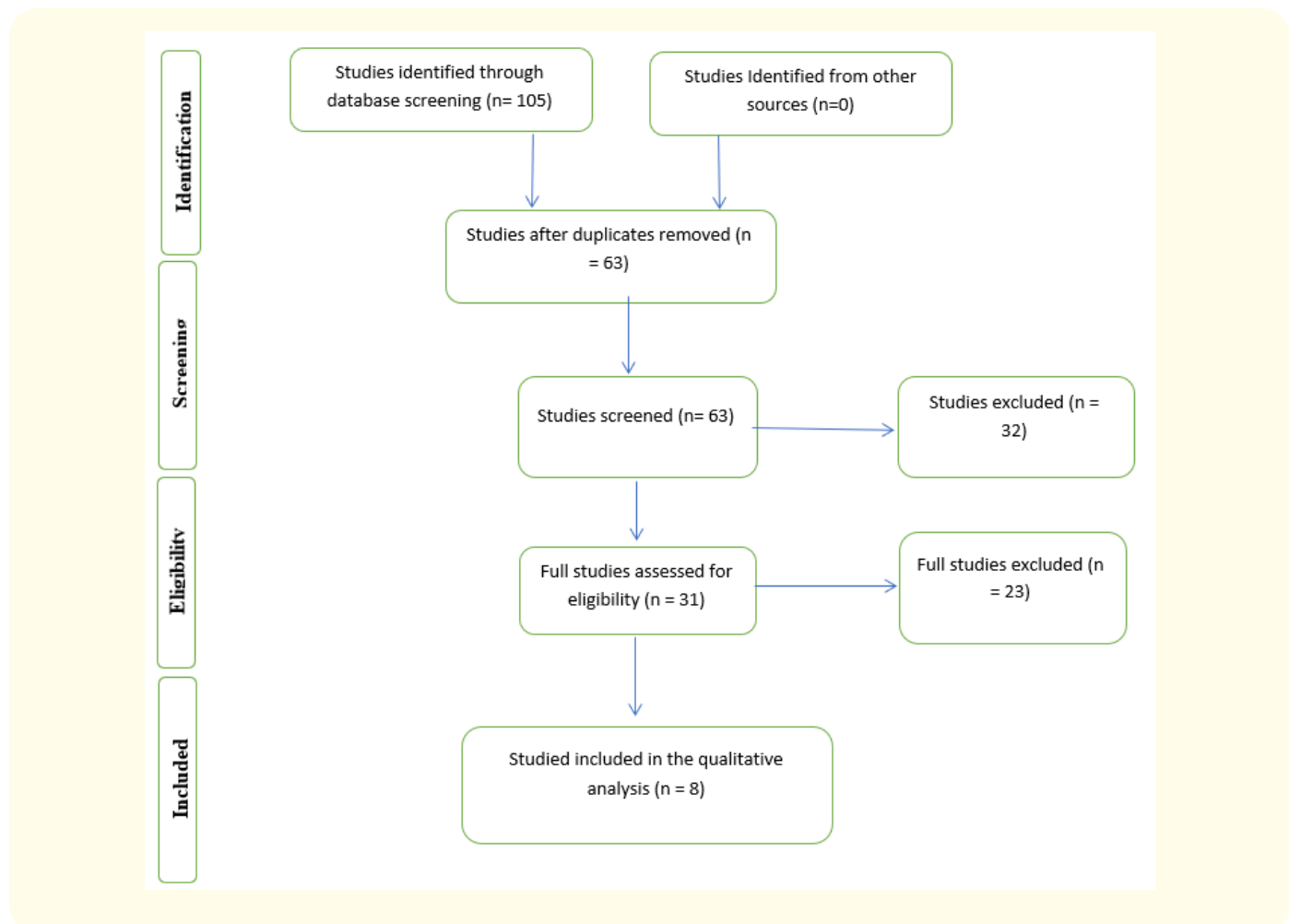
Newman, Nitza., *et al.* reported that; acute appendicitis was the most common community-acquired complicated intra-abdominal infections. *E. coli* was the most frequently isolated pathogen [20].

Cinat ME., *et al.* concluded that; intra-abdominal drainage with percutaneous catheter was effective with a single treatment in 70% of patients and increased to 82% with a second attempt. Percutaneous catheter drainage is a commonly used staging method for the resolution of intra-abdominal sepsis prior to corrective operation [21].

Chih-Hsien Lo., *et al.* found that; surgical skills can minimize the incidence of intra-abdominal infection, management also requires experience and training [22].

Kumar RR., *et al.* concluded that; many patients with intra-abdominal abscesses recovered with antibiotic treatment only. Patients with an abscess diameter > 6.5 cm and an ingestion temperature > 101.2°F are most likely to fail conservative antibiotic treatment alone and need percutaneous drainage [23].

**The included studies had different study designs**



## Discussion

An abdominal infection is not an uncommon presentation on the general surgery ward or to the emergency department. IAIs remain an important cause of morbidity and mortality in modern surgical practice worldwide. This study was conducted to review results of previous studies regarding intra-abdominal infections.

There is the wide variety of clinical entities within intra-abdominal infections. In addition to local abscess or solid organ infection (e.g. liver abscesses and infected pancreatic necrosis), a classical approach considers three types of peritonitis: main peritonitis (peritoneal dialysis-related or random bacterial peritonitis), secondary peritonitis (following anatomical disturbance of the GI tract) or tertiary peritonitis (persistent infection despite sufficient control intervention) [19]. Previous study reported that post-operative Intra-Abdominal Abscess (PIA) complicates 3% - 25% of appendectomies [24]. Asarias, *et al.* recorded a 30% rise in the risk of postoperative abscess for every decade of life in those with gangrenous or perforated appendicitis [25]. Patients requiring surgical resection for Crohn's disease recorded in 12%-28% of abdominal or pelvic abscess [26]. It is reported that 70% of patients are postoperative and that 6 percent of patients having colorectal surgery may develop a postoperative abscess. Hepatic abscesses account for 13% of all intra-abdominal abscesses [27]. Previous research indicated that the vast majority of cases included secondary peritonitis (68.4%), accompanied by bile duct infection (12.2%), intra-abdominal abscess (6.9%) and pancreatic infection (6.3%). Main peritonitis, toxic megacolon, peritoneal dialysis-related peritonitis and typhlitis were less common (< 4 per cent) [19].

The most common organisms involved in an abdominal abscess include a mixture of aerobic and anaerobic bacteria that originate from the gastrointestinal tract. Microbiological tests in 1982 (75.6 per cent) Gram-negative bacteria were most commonly isolated (58.6 per cent) with Enterobacterales as the main family (51.7 per cent) and *Escherichia coli* as the most widespread pathogen (36.8 per cent). Gram-positive aerobic bacteria have been isolated as the most dominant species in 39.4 percent of patients with enterococci (25.9 per cent). In comparison, anaerobic bacteria and fungi were isolated in 11.7% and 13.0% of patients respectively [19]. Overall prevalence of enterococci was 26% in another study [28]. The most frequently cultured organisms were *Escherichia coli*, *Candida* species, *Enterococcus* species, and *Streptococcus* species as reported in another study [29].

methicillin resistance for *Staphylococcus aureus*, vancomycin resistance for enterococci, and for Gram-negative bacteria either production of extended-spectrum beta-lactamase (ESBL), carbapenem resistance, or fluoroquinolone resistance (resistance against ciprofloxacin, levofloxacin, or moxifloxacin) was identified as anti-microbial resistance [30].

Multidrug-resistant micro-organisms were isolated from (26.3%) of a study sample. Antimicrobial resistance rates did not vary between community-acquired (26.5 per cent), early onset hospital-acquired (29.0 per cent) and late-onset hospital-acquired infection (24.6 per cent) ( $p = 0.215$ ). There was also no disparity in antimicrobial tolerance for patients with inflammation (27.6 per cent), sepsis (26.9 per cent) and septic shock (25.0 per cent) [19]. Multicenter analysis reporting antimicrobial resistance in 39% of infections in patients with no clear risk profile as shown by previous antibiotic exposure and/or hospitalization [31].

Complicated intra-abdominal infections (CIAIs) are a major cause of morbidity and mortality, especially when poorly handled. A new multi-center retrospective research conducted in 132 medical centres around the world involved 4553 patients with CIAIs. The average mortality rate in this study was 9.2 percent [32]. Another study reported overall mortality was 29.1% [19].

Management of intra-abdominal infection includes antibiotics, with or without percutaneous or operative drainage [33]. In a research performed by Keckler, *et al.* 52 pediatric patients had their drainage catheters removed at a period of 6 days, and the appendectomy interval was at a time of 62 days after the original diagnosis [34]. Roach, *et al.* identified 32 patients treated with abscess drainage and/or antibiotic treatment, with a latency of 6 weeks from initial presentation to eventual laparoscopic appendectomy [35]. Prolonged drainage (ranging from 8 days to 6 weeks) may be necessary if a fistula is present. A study by Rypens, *et al.* confirmed that 8 of 16 patients with

Crohn's disease-associated abscess had successful percutaneous abscess drainage [36]. Another study reported longer interval to surgery as 15 of 56 patients had percutaneous abscess drainage and waited an average of 64 days after their initial presentation, prior to undergoing an appendectomy [37]. Ambrosetti, *et al.* identified 73 patients who were treated conservatively with antibiotics, with or without abscess drainage, of which 71 per cent of pelvic abscesses and 51 per cent of mesocolic abscesses eventually needed surgery [38]. In a new article evaluating the therapeutic modality for intra-abdominal abscesses in 3,296 hospitalized patients with Crohn's disease, 39% were treated with antibiotics alone, 29% were treated with percutaneous drainage and 32% were treated with surgery; considering the rise in the use of conservative medication, there is no evidence on the effectiveness of these treatments compared to 32% [29].

## Conclusion

Intra-abdominal infection (IAI) is a comprehensive term that covers a number of infectious manners. The essential pragmatic treatment is established by identifying whether the infection is whether healthcare- or community-acquired, which organs are infected, and if the infection is complicated or uncomplicated. Anti-microbial resistance is of a huge importance and must be further studied to be well avoided.

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