

SEPTEMBER 2018

SYNERGISING MEDICAL MICROBIOLOGY, PATIENT SAFETY AND CLINICAL PRACTICE

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ESCHERICHIA coli is in the spotlight this month with National Kidney Awareness Week (2nd-8th September). Escherichia coli ('esher' 'eekea' 'kohl' 'eye' - usually abbreviated to '*E. coli*') is one of the most common causes of urinary tract infection and is also implicated in wound and bloodstream infections, mastitis, cholecystitis, neonatal meningitis and pneumonia, as well as a severe type of food poisoning.

E. coli is a large and diverse group of enterobacteria, which are found in the environment, foods, and the intestines of people and animals. It is used in public health as an indicator of faecal pollution (especially in water or food) and in medicine and genetics as an important research organism.

PATHOGENESIS AND SPECIAL CHARACTERISTICS

A rod-shaped, Gram-negative bacterium, *E. coli* possesses specialised structures on its cell membrane to assist with adhesion (**fimbriae**). Some strains also possess "**pili**", which transfer and accept **plasmids** (structures which contain genetic material and determine antibiotic resistance) to and from other species of bacteria, and in this way, add more strains into the existing *E. coli* population. These properties enable *E. coli* to survive under stressful conditions – so even though it has a simple cell structure, it can survive without oxygen (anaerobic) and perform complex metabolic activities to maintain its cell growth and rapid cell division.



Gram strain of *E. coli* illustrating its rod shaped morphology.



Electron micrograph of the H30 pandemic strain *E. coli*.

It is often a urinary tract pathogen, but can also infect the bloodstream and other areas.



Image clearly depicting the fimbriae *E. coli* uses for attachment, as well as specialised 'sex pili' which act as a conduit for the transfer of DNA between bacterial cells.

**FAST FACTS^{2,3}:**

- *E. coli* is usually a harmless commensal in the large intestine where it assists with digestion and nutrient absorption, as well as the production of vitamin K (essential for the clotting process).
- It has also been widely used in human and animal research to synthesize DNA and proteins. One of the most significant contributions of recombinant DNA from *E. coli* has been the production of human insulin for diabetes patients.
- The recurrence rate after a first *E. coli* urinary infection is 44% over 12 months.



THE SPECTRUM OF *E. coli* INFECTIONS

Urinary tract infection (UTI) – the most common site of *E. coli* infection, from uncomplicated urethritis, symptomatic and non-symptomatic cystitis, pyelonephritis, acute prostatitis and prostatic abscess, to life threatening urosepsis. More than 90% of all uncomplicated UTIs are caused by *E. coli* infection and primarily occur in females who are sexually active and are colonized by a uropathogenic strain of *E. coli*. Subsequently, the peri-urethral region is colonized from contamination of the colon, and the organism reaches the bladder during sexual intercourse.

Acute bacterial meningitis – most cases of neonatal meningitis are caused by *E. coli* and Group B *Streptococcal* infections. Pregnant women are at a higher risk of colonization with the K1 capsular antigen strain of *E. coli*, and this strain is commonly observed in neonatal sepsis with a mortality rate of 8%.

Most infant survivors have subsequent neurological or developmental abnormalities, especially those with a low birth weight and a positive cerebrospinal fluid (CSF) culture. *E. coli* meningitis is rare in adults, but may occur as a healthcare-associated complication following neurosurgical trauma or procedures involving the CNS.

Pneumonia – *E. coli* respiratory tract infections are uncommon and are almost always associated with an *E. coli* UTI. However, *E. coli* bronchopneumonia may also be community-acquired in patients who have an underlying disease such as diabetes mellitus, alcoholism or emphysema. Healthcare-associated *E. coli* pneumonia may also result from micro-aspiration of upper airway secretions in critically ill and ventilated patients.

Note: *E. coli* bacteraemia may precede pneumonia and is usually due to a pre-existing *E. coli* infection in the urinary or gastrointestinal tracts.

Intra-abdominal infections – these often result from a bowel perforation (e.g., the appendix, a diverticulum or disrupted colonic anastomosis) or are associated with an intra-abdominal abscess, cholecystitis or ascending cholangitis. Patients with diabetes mellitus are also at high risk of liver abscesses.

Enteric infections – *E. coli* O157:H7 is one of the most infective strains which causes food poisoning after the ingestion of contaminated ground beef, unpasteurized milk or contaminated water. The 'Shiga' toxin produced by this strain may cause stomach cramps, vomiting, acute dehydration, fever, bloody diarrhoea and kidney failure, and has been responsible for numerous outbreaks worldwide. Antibiotics are not routinely recommended for patients with suspected *E. coli* O157 diarrhoeal infections, and most cases resolve within 3 days with supportive management.



KEY TERMS

- **Endogenous infection** is caused by commensal microbes which, when transferred to a site where they are not normally resident, become pathogenic and cause infection.
- **Exogenous infection** is caused by pathogenic microorganisms acquired from external sources – for example, unwashed hands, contaminated equipment or the environment.

MODE OF TRANSMISSION AND INFECTION CONTROL PRECAUTIONS

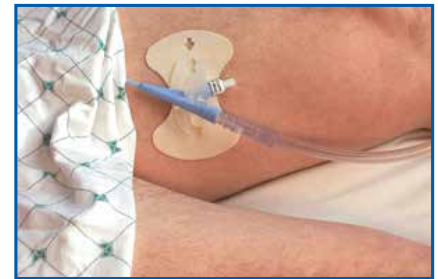
E. coli is spread via the 'contact route', which may be directly, via unwashed hands, or indirectly, through contact with contaminated surfaces, invasive catheters and shared patient equipment in the hospital setting.

Given the wide spectrum of infections caused by this pathogen, hand hygiene, aseptic technique and scrupulous attention to personal hygiene after using the toilet are key aspects for the prevention of transmission and the acquisition of infection.



THE 'BEST CARE – ALWAYS' CATHETER-ASSOCIATED URINARY TRACT INFECTION (CAUTI) PREVENTION BUNDLE

1. Avoid the unnecessary insertion of urinary catheters
2. Insert urinary catheters using strict aseptic techniques
3. Maintain catheters as per accepted clinical guidelines
4. Review the necessity for the catheter daily and remove promptly



WOUND FOCUS

- Poor compliance with hand hygiene and standard precautions in the clinical setting, combined with the inappropriate use of topical antimicrobials and systemic antibiotics, increase cross infection risk and drive antibiotic resistance.
- Faecal contamination and prolonged exposure to urinary ammonia raises wound pH levels above 8, and encourages the proliferation of species such as *enterococci*, *E. coli* and *Pseudomonas aeruginosa*.
- The presence of devitalized tissue underneath moist, occlusive dressings may further predispose to a high bacterial density - termed critical colonization of the wound bed - and the presence of anaerobes.
- All of the above should be considered when managing wounds adjacent to faecal fistulae, gastrointestinal (GIT) stomas and jejunostomy feeding tubes.

YOUR COMMENTS OR SUGGESTIONS FOR FUTURE TOPICS?

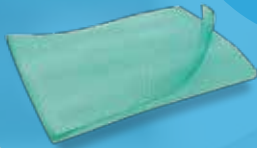
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RESOURCES

1. Centers for Disease Control (CDC) 2018. A – Z Index: Escherichia coli. <https://www.cdc.gov/ecoli/index.html> [Accessed 8.8.2018]
2. Madappa, T., Bronze, M. et al (2017) Escherichia coli Infections. Medscape online. <https://emedicine.medscape.com/article/217485-overview> [Accessed 8.8.2018]
3. MicrobeWiki (2014) Escherichia coli. https://microbewiki.kenyon.edu/index.php/Escherichia_coli [Accessed 8.8.2018]

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