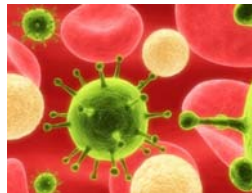


Vancouver Island Health Authority
COWICHAN DISTRICT HOSPITAL
ANTIMICROBIAL
EMPIRIC PRESCRIBING
GUIDELINES—ADULTS

2011
EDITION 2



Reviewed by
ANTIMICROBIAL REVIEW SUBCOMMITTEE

Infection Prevention and Control
ANTIMICROBIAL STEWARDSHIP
System Wide Initiative (SWI)

SWI Working Version: Edition 2

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INTRODUCTION

Appropriate use of antibiotic can shorten duration of treatment, reduce treatment failures and reduce selection pressure for resistant organisms, thus delaying emergence of resistance. Inappropriate use is often ineffective, costly, and encourages resistance and so effective therapies are lost.

Antibiotic therapy should normally be directed by results of microbiological investigations but when unavailable, and the patient's clinical condition demands it, empirical therapy has to be used.

With a local and global background of increasing antibiotic resistance and a total antibiotic expenditure within VIHA of over 2.2 million annually it is very important to make the most appropriate use of valuable resources.

Within VIHA the challenges of hospital acquired infections have been exemplified by the presence of outbreaks in 2006, 2007, 2008, and 2009. These outbreaks have been problematic and have involved multiple units within:

- NRGH – Norovirus (2006)
- RJH – VRE (2007)
- CDH – VRE (2007)
- NRGH – C. difficile (2008)
- SPH – C. difficile (2009)

In addition, the Clostridium difficile rate exceeds the national average of 5.2 cases per 1,000 admissions at NRGH (10.3).

The methacillin-resistant Staphylococcus aureus (MRSA) rate exceeds the national average of 6.3 per 1000 admissions at CDH – (7.6) and Port Hardy Hospital (9.4)

This booklet contains guidelines for empirical therapy in adult patients for select infections commonly encountered in community and hospital practice.

GOOD PRACTICE POINTS

IS AN ANTIBIOTIC NEEDED?

- The reason for prescribing an antibiotic should be documented.
- Antibiotics are not a substitute for, but should be used in conjunction with, basic surgical principles e.g. abscess drainage, etc.

START

- **Prior antibiotic use in the last 3 months is a significant consideration in empiric therapy selection. A class effect may need to be considered.**
- Always check allergy status.
- Follow the guidelines when choosing therapy unless microbiology results or patient factors dictate otherwise.
- Where there are no guidelines or whenever the prescriber is uncertain, seek expert advice (Medical Microbiology contact details at the end of this booklet).

• **OBTAIN CULTURE. Antimicrobial therapy should not be delayed in an emergency, but every effort should be made to obtain all necessary specimens BEFORE therapy starts.**

- Ensure **dosage** is appropriate for site and severity of infection, route, age, weight, renal, and hepatic function. **The doses included in the guidelines are for adults with normal renal and hepatic function.**
- All antibiotics should be prescribed with a course length or review date on the prescription.
- Use the oral route whenever possible.
- If the intravenous route is used refer to the VIHA IV Monograph (on Intranet) for administration details.

REVIEW

- Always **review** regularly and **adjust** therapy in accordance with microbiology findings and patient response.
- All reviews and changes in therapy should be documented in the patient's medical notes with reasons.

IV to ORAL SWITCH (Sequential / Switch Therapy)

The majority of patients who initially need IV therapy can be safely switched to oral therapy within 48 hours.

Switching to effective oral therapy:

- Increases patient comfort, and mobility.
- Reduces complications of IV therapy (e.g. phlebitis, line infection, extravasations).
- Reduces preparation & administration time for staff.
- Reduces risk of needle-stick injury.
- Facilitates earlier discharge planning.
- Reduces expenditure on drugs and consumables.
- Reduces generation of hospital waste.

The need for continued IV therapy should be reviewed daily.

Selection criteria for IV to ORAL Sequential Therapy

- There is sufficient microbiological information about the pathogen and its sensitivities; or clinical improvement on initial therapy.
- Patient clinically stable:
 - afebrile for at least 24 hours.
 - normal or near normal WBC & differential.
 - improving signs and symptoms.
- Patient is able to take oral medication.
- Patient has a functional GI tract – see below.
- Patient does not have a high risk infection – see below.
- A suitable oral alternative is available – see below.

Conditions That May Affect Absorption

- Continuous NG suction.
- Malabsorption syndromes (e.g. blind loop syndrome, short-bowel syndrome, Whipples disease).
- Ileus.
- Protracted vomiting.
- Severe diarrhea.

High Risk Infections

In certain situations intravenous therapy should be continued. Examples of such infections are: endocarditis, meningitis, osteomyelitis, some bacteremias and septicemias, infections in immunosuppressed patients, and some abscesses. If in doubt, consult a Medical Microbiologist or Infectious Disease physician.

Recommended Oral Alternatives to SELECT IV Antibiotics

Parenteral Regimen¹	Oral Regimen	Oral bio-avail. (%)	Drug Acq. Cost Savings /Day²
Ampicillin 1 g q6h	Amoxicillin 500 mg q8h	75	\$ 3
Azithromycin 500 mg IV daily	Clarithromycin 250-500 mg q12h	55	\$ 20
Cefazolin 1 g q8h	Cephalexin ³ 500 mg q6h	90	\$ 2
Cefuroxime 750 mg q8h	Cefuroxime axetil 500 mg q12h	52	\$ 9
Ciprofloxacin 200 mg q12h	Ciprofloxacin 250 mg q12h	70	\$ 4
Ciprofloxacin 400 mg q12h	Ciprofloxacin 500 mg q12h	70	\$ 5
Clindamycin 600 mg q8h	Clindamycin 600 mg q8h	90	\$ 8
Cloxacillin 1 g q6h	Cloxacillin 500 mg q6h	35-50	\$ 16
Fluconazole 200 mg daily	Fluconazole 200 mg daily	90	\$ 3
Metronidazole 500 mg q12h	Metronidazole 500 mg q12h	100	\$ 1.30
Moxifloxacin 400 mg daily	Moxifloxacin 400 mg daily	90	\$ 17

Parenteral antibiotics were not included in above if they were:

- Restricted or non formulary status.
- Dependent on microbiology results.

Footnotes to IV to Oral Sequential therapy Table

1. Usual adult dose in patients with normal renal and hepatic function.
2. Drug acquisition costs only. Does not include preparation or administration costs.
3. Can switch for gram positive organisms if susceptible to cefazolin; for gram negative organisms can switch ONLY if susceptible to cephalothin (lab marker for cephalexin).

STOPPING ANTIMICROBIALS

Many infections have resolved after 3 to 7 days of antibiotic treatment. **State a duration in which you intend to stop or review the order so that other caregivers will understand your intentions.**

VIHA Anti-infective Auto-Stop Order Intervals

DESCRIPTION	INTERVAL
Anti-infectives oral and injectable	5 days
<i>Exceptions</i>	
Antifungals Oral and Topical	14 days
Antifungal shampoos	90 days
Antimycobacterials: Oral (includes ethambutol, isoniazid, pyrazinamide, and rifampin).	90 days

Note: Each antibiotic modification or renewal automatically resets the stop-date to the full ASO interval unless a stop-date or duration of treatment is specified on the order.

EMPIRICAL TREATMENT OF SELECTED INFECTIONS

PRIOR ANTIBIOTIC USE in the last 3 months is a significant consideration in empiric therapy selection. A class effect may need to be considered.

EAR, NOSE & THROAT

Otitis Media

ACUTE

- **80% of uncomplicated cases in previously healthy individuals usually resolve within 3 days.**
- S. pneumonia sensitivity: Amoxicillin (98%), cefuroxime (92%), TMP/SMX (72%) & erythromycin (75%).

USUAL PATHOGENS	Recommended Empiric Therapy (7-10 days)
S. pneumonia H. influenza M. catarrhalis Grp A Streptococcus S. aureus	Amoxicillin 500 mg PO TID <i>Penicillin allergic (rash):</i> Cefuroxime axetil 500 mg PO BID <i>Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedema):</i> Clarithromycin 500 mg PO BID OR TMP/SMX 1 DS tab PO BID

COMPLEX OR CHRONIC CASES

Refer to BUGS & DRUGS: http://www.bugsanddrugs.ca/ OR Consult with Medical Microbiology / Infectious Disease.
<ul style="list-style-type: none"> • Failure of First-line Agents <ul style="list-style-type: none"> ○ Persistent (greater than 7 days) • Chronic <ul style="list-style-type: none"> ○ Recurrences less than 6 weeks apart ○ Recommend ENT consult

Sinusitis (Bacterial)

ACUTE

Viral etiology > 98%, antibiotics NOT typically recommended.

A clinician should diagnose acute bacterial rhinosinusitis (ABRS) when symptoms or signs of acute rhinosinusitis:

- a) Are present 10 days or more beyond the onset of upper respiratory symptoms; OR
- b) Worsen within 10 days after an initial improvement (double worsening).

USUAL PATHOGENS	Recommended Empiric Therapy (10 days)
S. pneumonia H. influenza M. catarrhalis Occasionally: - S. aureus - Grp A Strep. - Anaerobes	Amoxicillin 500 mg PO TID <i>Penicillin allergic (rash):</i> Cefuroxime axetil 500 mg PO BID <i>Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedema):</i> Doxycycline 100 mg PO BID (<i>with food</i>), OR Clarithromycin 500 mg PO BID, OR TMP/SMX 1 DS tab PO BID days

COMPLEX OR CHRONIC CASES

<p>Refer to BUGS & DRUGS: http://www.bugsanddrugs.ca/ OR Consult with Medical Microbiology / Infectious Disease.</p> <ul style="list-style-type: none"> • Failure of First-line Agents <ul style="list-style-type: none"> ○ Clinical deterioration after 72 h of antibiotic therapy. ○ No improvement post therapy. • Acute Recurrent <ul style="list-style-type: none"> ○ More than 3 episodes / year and each episode is 10 or more days in duration. ○ Complete resolution between episodes. ○ Recommend referral to ENT specialist. • Chronic <ul style="list-style-type: none"> ○ Symptoms last for 12 or more weeks.
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Laryngitis

- Viral
- **No antibiotic therapy recommended.**

Tonsilo-pharyngitis

- Antibiotics are rarely indicated, most infections are viral and bacterial infections are usually self-limiting.
- The following are more likely in GAS pharyngitis:
 - Fever.
 - Tenderness/enlargement of anterior cervical lymph nodes.
 - Absence of cough or rhinorrhea.
 - Strep throat exposure in previous 2 weeks.
- **Throat swab recommended & treat according to C&S results**

ACUTE (Group A Streptococci)

- Macrolide and clindamycin resistance has been increasing.
- No in vitro resistance to penicillin.

PATHOGEN	Recommended Empiric Therapy (10 days)
Group A Streptococci	<p><i>Therapy can be delayed while awaiting throat culture results and still prevent rheumatic fever.</i></p> <p>Penicillin VK 600 mg PO BID</p> <p><i>Penicillin allergic (rash):</i> Cephalexin 500 mg PO QID</p> <p><i>Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedema):</i> Clarithromycin 500 mg PO BID</p>

COMPLEX OR CHRONIC CASES

<p>Refer to BUGS & DRUGS: http://www.bugsanddrugs.ca/ OR Consult with Medical Microbiology / Infectious Disease.</p>
<ul style="list-style-type: none"> • Non responders (72 h) • Early relapse (2-7 days post therapy) • Late relapse or recurrent (confirm by culture)

GASTROINTESTINAL

DEFINITIONS USED FOR RISK STRATIFICATION TO GUIDE THERAPY

The following definitions were extracted from the Canadian practice guidelines for surgical intra-abdominal infections. The guidelines are endorsed by the Association of Medical Microbiology and Infectious Disease (AMMI) Canada and the Canadian Association of General Surgeons (CAGS) Committee on Acute Care Surgery and Critical Care.

REFERENCE: Chow AW et al. Canadian practice guidelines for surgical intra-abdominal infections. *Can J Infect Dis Med Microbiol* Vol 21 No 1 Spring 2010:11-37.

Community-Acquired

- Involve conditions such as gastroduodenal perforation, ascending cholangitis, cholecystitis, appendicitis or diverticulitis with or without perforation, and pancreatitis without previous surgical intervention or hospitalization.

Healthcare-Associated

- An infectious process that is absent at the time of hospital admission, but becomes evident at 48 hours or more after admission, and includes anastomotic leaks and perforations as well as abscesses that develop as complications of surgery.
- Also includes infections acquired during the course of receiving treatment for other conditions in a health-care setting, including the nursing home, dialysis unit or surgical daycare, within the previous 12 months.

SEVERITY

Categorize by clinical impression:

- Mild to moderate severity (e.g. APACHE II scores less than 15).
- High severity (e.g. APACHE II score equal to or greater than 15).

RISK

Identify high-risk patients for poor outcome by following criteria:

- Community-acquired versus healthcare-associated (see above).
- Previous antibiotic exposure (previous 90 days).
- Underlying co-morbid conditions such as diabetes, severe cardiopulmonary disease or immunosuppression.

Gastroenteritis (Acute)

- Avoid antimotility agents until you have ruled out *C. difficile* or *E. coli* 0157:H7 as the cause.
- Do not use bismuth subsalicylate with quinolones as binding decreases quinolone absorption.

MILD-MODERATE

Antibiotic therapy is NOT recommended unless symptoms severe or prolonged.

SEVERE

Severity criteria (one or more):

Defined as including one or more of the following criteria (± fever):

- approximately 6 or more diarrheal episodes per day
- bloody diarrhea
- persistent diarrhea (greater than 3 days)
- If patient has a sepsis presentation, treat as sepsis with a GI source. Refer to early goal directed therapy protocol (not currently provided in these guidelines).
- Culture and *C. difficile* toxin recommended.
- *C. difficile* can be a community-associated infection and is not always associated with recent antibiotic use or hospital exposure.
 - ⇒ Bloody diarrhea in afebrile patients should increase suspicion of *E. coli* 0157:H7. **No antibiotic therapy recommended since it may enhance toxin release and increase risk of hemolytic uremic syndrome (HUS).**
- Consider *Campylobacter* spp. in persons with travel history.

<p>CULTURE PENDING – NO clinical suspicion of HUS, <i>C. difficile</i>, or Sepsis (Treat for 5 days)</p>
<p>Ciprofloxacin 500 mg PO bid</p> <p><u>Alternative</u> TMP/SMX 1 DS tab PO bid</p> <hr/> <p><i>If travel history and suspicion of <i>Campylobacter</i> spp:</i></p> <p>Clarithromycin 500 mg PO BID, OR Erythromycin 500 mg PO QID</p> <p><u>Alternative</u> Ciprofloxacin 500 mg PO bid</p>

Clostridium Difficile Infection (CDI)

The VIHA Antimicrobial Review Subcommittee has developed a **bulletin that provides greater detail CDI on the treatment algorithm for adult and pediatric patients** which can be accessed on the VIHA intranet at:

It can also be accessed from the VIHA **Intranet Home Page** by:

1. Selecting **Clinical Resources** from the banner.
2. Selecting **Infectious Disease** in the **Quick Links** section.

RISK FACTORS

Risk factors for CDI are generally divided into three main groups:

1. Host factors: age greater than 65 years; female sex; multiple comorbidities; immune compromised.
2. Disruption of normal intestinal microflora: antibiotic exposure within 3 months; medications affecting intestinal tract; loss of intestinal function (ileus, obstruction); chemotherapy; antacids/proton pump inhibitors; procedures (surgery, nasogastric tube, enemas).
3. Increased exposure to *C. difficile*: admission to hospital; admission to Long Term Care (LTC) facility; poor hand hygiene; infected hospital roommate; prior CDI episodes.

LAB DIAGNOSIS

- Patients with suspected CDI should have a stool sample submitted. Formed stool is not appropriate.
- In VIHA, the sample is first screened for *C. difficile* antigen. If the test is negative, no further testing is necessary. If the antigen test is positive then a second test is performed which is an enzyme immunoassay (EIA) test for *C. difficile* A and B toxins. The turnaround time (TAT) for this test is less than 24 hours and STAT tests can be arranged following consultation with the medical microbiologist on call.
- All positive tests are communicated to the ward for inpatients and to the physician's office for outpatients.
- If the antigen test is positive but the toxin EIA assay is negative this generally indicates that the patient is colonized with a non-toxin-producing strain of *C. difficile*.

TREATMENT

Initial episode

- Mild-to-moderate infection:
Metronidazole 500 mg orally 3 times daily (or 250 mg orally 4 times daily) for 10 to 14 days.
- Severe infection or unresponsiveness to or intolerance of metronidazole:
Vancomycin 125 mg orally 4 times daily for 10 to 14 days.

First recurrence†

- Mild-to-moderate infection:
Metronidazole 500 mg orally 3 times daily for 10 to 14 days.
- Severe infection or unresponsiveness to or intolerance of metronidazole:
Vancomycin 125 mg orally 4 times daily for 10 to 14 days.

Second recurrence†

- Vancomycin 125 mg orally 4 times daily for 14 days.
- If patient has previously received vancomycin proceed to tapering therapy described below.

Third / subsequent recurrence(s)†

- Vancomycin in tapered and pulsed doses:
 - 125 mg orally 4 times daily for 14 days
 - 125 mg orally 2 times daily for 7 days
 - 125 mg orally once daily for 7 days
 - 125 mg orally once every 2 days for 14 days

PROBIOTICS †

- A probiotic agent such as *Saccharomyces boulardii* may be added, administered as 500 mg (2 x 250 mg capsules) orally 2 times daily for at least 4 weeks.
- Probiotic therapy may commence with the initiation of antimicrobial therapy. However, the efficacy of probiotics in preventing recurrent *C. difficile* infection is unclear because of inconsistent study results.
- Bacteremia or fungemia may rarely complicate the use of probiotics in immunocompromised or critically ill patients.

ADDED NOTES

- A paramount treatment principle is discontinuation of the inciting antibiotic as soon as possible.
- A positive toxin assay in a patient with minimal or no symptoms should NOT prompt treatment.
- Metronidazole and vancomycin show similar efficacy in patients with mild infection. Due to the risk of emergence of VRE as well as additional cost associated with vancomycin usage, **metronidazole remains the preferred agent in patients with mild-to-moderate infection**. Vancomycin may be considered as first-line therapy in patients who are greater than 75 years old, have comorbidities and/or who are immunosuppressed.
- Vancomycin is recommended as first-line therapy in patients with severe infection because of more prompt symptom resolution and lower risk of treatment failure. Determination of disease severity is left to clinician judgement and may include any or all of: a marked peripheral leukocytosis; renal dysfunction; severe abdominal pain; fever; hypotension; ileus; or toxic megacolon.
- Severely ill patients with ileus may have markedly delayed passage of oral antibiotics from the stomach to the colon. These individuals may benefit from the addition of intravenous metronidazole at a dose of 500 mg every eight hours.
- Surgery should be considered if the patient's clinical status fails to improve. Toxic megacolon should be suspected if the patient develops abdominal distention with diminution of diarrhea; this may reflect paralytic ileus resulting from loss of colonic muscular tone.
- Not all patients with recurrent diarrhea following cessation of metronidazole or vancomycin therapy have recurrent CDI. Other conditions, such as post infectious irritable bowel syndrome, microscopic colitis or inflammatory bowel disease may be responsible.
- A 14-day course of metronidazole 500 mg PO TID costs approximately \$4.00 versus a 14-day course of vancomycin 125 mg PO QID which costs approximately \$400.

PREVENTION

Given the significant morbidity and mortality associated with CDI it is critical that appropriate measures be undertaken to prevent infection and transmission. A multifaceted approach of prudent antimicrobial use along with stringent infection control including hand washing with soap and water, early institution of contact precautions and disinfection of rooms with a bleach solution to kill spores are all essential in preventing CDI and controlling its spread.

Cholecystitis / Cholangitis

MILD SEVERITY

- Symptoms mirror minor biliary colic
- **DOES NOT require antimicrobial therapy**

MODERATE SEVERITY or RISK

Severity criteria (one or more):

- Steady and severe pain (RUQ or epigastrium)
- Fever
- Leukocytosis

Additional Points:

- PRIOR ANTIBIOTIC USE in the last 3 months is a significant consideration in empiric therapy selection. A class effect needs to be considered.
- **Anaerobic coverage (with metronidazole)** is acknowledged to be controversial for moderate severity cholecystitis /cholangitis.
- **Shorter durations of therapy** should be encouraged when patients exhibit significant clinical improvement.
- Blood cultures recommended (particularly for cholangitis).

USUAL PATHOGENS	Recommended Empiric Therapy (4 - 7 days)
Enterobacteriaceae Anaerobes	[Cefazolin 1 g IV q8h + Metronidazole 500 mg IV/PO q8h]
Enterococcus spp (not routinely covered for moderately severe infections)	<i>Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedema):</i> [Ciprofloxacin 400 mg IV / 500 mg PO q12h + Metronidazole 500 mg IV/PO q8h]

SEVERE or HIGH RISK

Severity criteria:

- Septic presentation (includes the following):
 - Systemic inflammatory response syndrome (SIRS): hypothermia or fever; tachycardia; tachypnea or hypocapnia (arterial CO2 less than 32 mm Hg); and leukopenia or leukocytosis.
 - Evidence of organ dysfunction, hypotension (low blood pressure), or hypoperfusion to 1 or more organs.

EMPIRICAL TREATMENT OF SELECT INFECTIONS – ADULT GUIDELINES

- Arterial hypotension or hypoperfusion is responsive to adequate fluid resuscitation. If unresponsive see empiric therapy for SEPTIC SHOCK below.

High Risk criteria (one or more):

- Healthcare-associated infection.
- Recent ERCP or stent in place.
- Patient has bilio-enteric anastomosis, e.g. post pancreaticoduodenectomy (Whipple's procedure).
- Liver transplant.
- Those requiring enterococcal coverage such as:
 - Antimicrobial exposure in the last 90 days to cephalosporins and other broad-spectrum regimens selecting for enterococci.
 - With valvular heart disease or intravascular prosthetic devices.
 - Severe immunosuppression (e.g. solid organ transplant, or high-dose steroids).

Additional Points

- **PRIOR ANTIBIOTIC USE in the last 3 months is a significant consideration in empiric therapy selection. A class effect needs to be considered.**
- Blood cultures recommended (high risk of bacteremia).
- Drainage of obstructed biliary tree is essential for therapy of cholangitis.
- The severely ill patient with cholangitis may take slightly longer to resolve compared to the surgically treated cholecystitis patient.

USUAL PATHOGENS	Recommended Empiric Therapy (7 – 10 days) Duration should be guided by intraoperative findings and clinical response and should be no more than 7 days in most cases.
Enterobacteriaceae Enterococcus spp Anaerobes	Piperacillin-tazobactam 3.375 g IV q6h <i>Penicillin allergic (clear history):</i> [Ciprofloxacin 400 mg IV q12h + Metronidazole 500 mg IV q8h + Vancomycin 15 mg/kg (round to nearest 250 mg) IV q12h]. Adjust vancomycin interval based on GFR.

SEPTIC SHOCK

Criteria (includes all of the following):

- Systemic inflammatory response syndrome (SIRS) which includes hypothermia or fever; tachycardia; tachypnea or hypocapnia (arterial CO₂ less than 32 mm Hg); and leukopenia or leukocytosis.
- Evidence of organ dysfunction, hypotension (low blood pressure), or hypoperfusion to 1 or more organs.
- Arterial hypotension or hypoperfusion (despite adequate fluid resuscitation) resulting in the need for vasopressors.

Additional Points:

- Implement antibiotics immediately. Broad-spectrum agents should be infused first.
- Consult intensive care.

Recommended Empiric Therapy (7 – 10 days)

Duration should be guided by intra-operative findings and clinical response and should be no more than 7 days in most cases.

[**Imipenem** 500 mg IV q6h +

Vancomycin 20 mg/kg (round to nearest 250 mg) x 1 dose, then 15 mg/kg (round to nearest 250 mg) IV q12h]. Adjust vancomycin interval based on GFR.

Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedemia):

[**Ciprofloxacin** 400 mg IV q12h +

Gentamicin 2 mg/kg IV x STAT (further dosing to be reassessed by the attending intensivist) +

Metronidazole 500 mg IV q8h +

Vancomycin 20 mg/kg (round to nearest 250 mg) x 1 dose, then 15 mg/kg (round to nearest 250 mg) IV q12h. Adjust interval based on GFR.]

Pancreatitis

Several classifications exist for prediction of acute pancreatitis severity. A commonly used classification system (the Atlanta classification) divides acute pancreatitis into two broad categories:

1. Mild (edematous and interstitial acute) pancreatitis.
2. Severe (usually synonymous with acute necrotizing) pancreatitis.

For detailed guidance on staging please refer to VIHA online resources such as Up-To-Date.

MILD – MODERATE

- **No prophylactic or empiric antibiotic therapy is required unless there is a documented infection.**

SEVERE

- **The administration of prophylactic antibiotics to patients with severe necrotizing pancreatitis prior to the diagnosis of infection is NOT recommended.**
- Initiate antimicrobial therapy in proven secondary infection or when the patient is hemodynamically unstable and requiring vasopressors.
- It not possible to differentiate necrotizing pancreatitis from infected necrotizing pancreatitis on the basis of a CT scan alone. Fine needle aspirate is required.
- Surgical debridement and drainage with culture is essential for established infections.
- Blood cultures recommended (high risk of bacteremia).

USUAL PATHOGENS	Recommended Empiric Therapy (Duration based on clinical improvement)
Enterobacteriaceae Enterobacter spp S. aureus Coagulase negative Staph Anaerobes	Piperacillin-tazobactam 3.375 g IV q6h OR Imipenem 500 mg IV q6h <i>Penicillin allergic (clear history)</i> [Ciprofloxacin 400 mg IV q12h Metronidazole 500 mg IV q8h + Vancomycin 15 mg/kg (round to nearest 250 mg) IV q12h]. Adjust vancomycin interval based on GFR.

Diverticulitis

MILD-MODERATE

- Generally considered to be *uncomplicated* acute diverticulitis. See definition of *complicated* acute diverticulitis below under SEVERE.
- **Typically managed on an ambulatory basis with oral therapy.**
- The decision to manage on an outpatient basis depends on several factors including the severity of presentation, the ability to tolerate oral intake, and the presence of comorbid diseases.
- Duration directed by clinical response.

USUAL PATHOGENS	Recommended Empiric Therapy (4 – 7 days)
POLYMICROBIAL: - Enterobacteriaceae - Anaerobes - Enterococcus spp*	Oral Preferred
	Amoxicillin-clavulanate 500 mg PO TID OR [TMP/SMX 1 DS tab PO BID + Metronidazole 500 mg PO TID] OR [Ciprofloxacin 500 mg PO BID + Metronidazole 500 mg PO TID]
	IV Regimen (if initially unable to take orally)
	[Ceftriaxone 1 g IV q24h plus/minus Metronidazole 500 mg IV q8h] <i>Switch to one of the above oral regimens when able to tolerate.</i>

* Coverage of Enterococcus is controversial. Only amoxicillin-clavulanate covers Enterococcus.

SEVERE

- Requires hospitalization.
- Includes:
 - Complicated diverticulitis (i.e. patients with perforation, obstruction, an abscess, or fistula).
 - Uncomplicated diverticulitis in the frail elderly, immunosuppressed, those with significant comorbidities, and those with high fever or significant leukocytosis.
- Duration directed by clinical response.

USUAL PATHOGENS	Recommended Empiric Therapy (7 – 10 days)
POLYMICROBIAL: - Enterobacteriaceae - Anaerobes - Enterococcus spp*	Piperacillin-tazobactam 3.375 g IV q6h <i>Penicillin allergic (clear history)</i> [Ciprofloxacin 400 mg IV q12h Metronidazole 500 mg IV q8h + Vancomycin 15 mg/kg (round to nearest 250 mg) IV q12h]. Adjust vancomycin interval based on GFR.

Cirrhotic Patients with Active Upper GI Bleed

Patients with cirrhosis who present with upper GI bleeding (from varices or other causes) should be given prophylactic antibiotics, preferably before endoscopy (although effectiveness has also been demonstrated when given after endoscopy).

Recommended Prophylactic Regimen (Continue for 7 days)
Ceftriaxone 1g IV q24h <i>If severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedemia):</i> Consult Medical Microbiologist or Infectious Disease physician.

Peritonitis – Spontaneous Bacterial (Primary)

Is typically defined as a group of diseases with different causes, having in common only an infection in the peritoneal cavity without an obvious source of peritoneal contamination, such as in patients with chronic liver disease and ascites.

- Take blood and peritoneal fluid cultures.
- Spontaneous bacterial peritonitis (SBP) is typically monomicrobial. Polymicrobial infections suggest bowel perforation – see secondary peritonitis.

USUAL PATHOGENS	Recommended Empiric Therapy (5-7 days)
Enterobacteriaceae Occasionally: - <i>S. pneumoniae</i> - <i>Streptococcus</i> spp.	Ceftriaxone 1 g IV q24h <u>Oral (sequential therapy) regimens</u> Amoxicillin-clavulanate 500 mg PO TID <i>Penicillin allergic (clear history):</i> TMP/SMX 1 DS tab PO BID

Peritonitis – Secondary

Refers to infections that arise from microbes in the alimentary tract – due to perforation of a hollow viscus causing contamination of the otherwise sterile peritoneal cavity.

USUAL PATHOGENS – POLYMICROBIAL

- Enterobacteriaceae
- Anaerobes
- Enterococcus spp (routine coverage typically not required)

MILD to MODERATE

Severity criteria (one or more):

- Steady and severe pain (RUQ or epigastrium)
- Fever
- Leukocytosis

Additional Points:

- PRIOR ANTIBIOTIC USE in the last 3 months is a significant consideration in empiric therapy selection. A class effect needs to be considered.
- **Shorter durations of therapy** should be encouraged when patients exhibit significant clinical improvement.
- Obtain blood cultures.

USUAL PATHOGENS	Recommended Empiric Therapy (4 - 7 days)
Enterobacteriaceae Anaerobes	[Cefazolin 1 g IV q8h + Metronidazole 500 mg IV/PO q8h]
Enterococcus spp (not routinely covered for moderately severe infections)	<i>Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedema):</i> [Ciprofloxacin 400 mg IV / 500 mg PO q12h + Metronidazole 500 mg IV/PO q8h]

SEVERE

Severity criteria:

- Septic presentation (includes the following):
 - Systemic inflammatory response syndrome (SIRS): hypothermia or fever; tachycardia; tachypnea or hypocapnia (arterial CO₂ less than 32 mm Hg); and leukopenia or leukocytosis.
 - Evidence of organ dysfunction, hypotension (low blood pressure), or hypoperfusion to 1 or more organs.
 - Arterial hypotension or hypoperfusion is responsive to adequate fluid resuscitation. If unresponsive – see empiric therapy for SEPTIC SHOCK below.

High Risk criteria (one or more):

- Healthcare-associated infection.
- Those requiring enterococcal coverage such as:
 - Antimicrobial exposure in the last 90 days to cephalosporins and other broad-spectrum regimens selecting for enterococci.
 - With valvular heart disease or intravascular prosthetic devices.
 - Severe immunosuppression (e.g. solid organ transplant, or high-dose steroids).

Additional Points

- **PRIOR ANTIBIOTIC USE in the last 3 months is a significant consideration in empiric therapy selection. A class effect needs to be considered.**
- Blood cultures recommended (high risk of bacteremia).

USUAL PATHOGENS	Recommended Empiric Therapy (7 – 10 days) Duration should be guided by intraoperative findings and clinical response and should be no more than 7 days in most cases.
Enterobacteriaceae Enterococcus spp Anaerobes	Piperacillin-tazobactam 3.375 g IV q6h <i>Penicillin allergic (clear history):</i> [Ciprofloxacin 400 mg IV q12h + Metronidazole 500 mg IV q8h + Vancomycin 15 mg/kg (round to nearest 250 mg) IV q12h]. Adjust vancomycin interval based on GFR.

SEPTIC SHOCK

Criteria (includes all of the following):

- Systemic inflammatory response syndrome (SIRS) which includes hypothermia or fever; tachycardia; tachypnea or hypocapnia (arterial CO₂ less than 32 mm Hg); and leukopenia or leukocytosis.
- Evidence of organ dysfunction, hypotension (low blood pressure), or hypoperfusion to 1 or more organs.
- Arterial hypotension or hypoperfusion (despite adequate fluid resuscitation) resulting in the need for vasopressors.

Additional Points:

- Implement antibiotics immediately. Broad-spectrum agents should be infused first.
- Consult intensive care.

Recommended Empiric Therapy (7 – 10 days)

Duration should be guided by intra-operative findings and clinical response and should be no more than 7 days in most cases.

[**Imipenem** 500 mg IV q6h +

Vancomycin 20 mg/kg (round to nearest 250 mg) x 1 dose, then 15 mg/kg (round to nearest 250 mg) IV q12h. Adjust interval based on GFR.]

Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedemia):

[**Ciprofloxacin** 400 mg IV q12h +

Gentamicin 2 mg/kg IV x STAT (further dosing to be reassessed by the attending intensivist) +

Metronidazole 500 mg IV q8h +

Vancomycin 20 mg/kg (round to nearest 250 mg) x 1 dose, then 15 mg/kg (round to nearest 250 mg) IV q12h. Adjust interval based on GFR.]

RESPIRATORY TRACT

Acute Bronchitis

- Viral
- No antibiotic therapy recommended

NOTE: Whooping cough (Bordetella pertussis):

- May mimic acute bronchitis and is underdiagnosed.
- Higher incidence seen with adults on Vancouver Island.
- Investigate if persistent cough (greater than 3 weeks), especially if associated with vomiting.

Acute Exacerbation of Chronic Bronchitis (AECB)

- Underlying chronic bronchitis or COPD.
- Patient has at least two of the following: increase sputum, purulence, or dyspnea.

UNCOMPLICATED

- No previous antibiotics in past 3 months AND/OR
- Less than 4 episodes/year

USUAL PATHOGENS	Recommended Empiric Therapy (5-7 days)
Haemophilus spp S. pneumonia Moraxella catarrhalis	Amoxicillin 500 mg PO TID OR Doxycycline 100 mg PO BID <i>with food</i> OR TMP/SMX 1 DS tab PO BID

COMPLEX OR CHRONIC CASES

<p>Refer to BUGS & DRUGS: http://www.bugsanddrugs.ca/ OR Consult with Medical Microbiology / Infectious Disease</p> <ul style="list-style-type: none"> • Complicated – previous antibiotics in past 3 months AND/OR greater than 3 episodes/year • Treatment failure

Community Acquired Pneumonia (CAP)

Prior antibiotic use in the last 3 months is a significant risk factor in all settings. A class effect may need to be considered.

Common Pathogens		
No Comorbid Factors	Comorbid Factors	
S. pneumoniae M. pneumoniae C. pneumoniae	S. pneumoniae C. pneumoniae H. influenza	M. catarrhalis Enterobacteriaceae S. aureus

FIRST LINE

The following antibiotic regimens are not altered by the presence of comorbid factors: asthma, lung cancer, COPD, diabetes, alcoholism, etc.

Treatment Setting	Modifying Factors	First Line Regimens (7-10 days) Refer to recommendation in pen or cephalosporin allergies
OUT-PATIENT	None	Doxycycline 100 mg PO BID <i>with food</i> , OR Clarithromycin 500 mg PO BID
	Antibiotics last 3 months	Choose a different class than previous and ADD Amoxicillin 1 g PO TID OR Amox-clavulanate 500 mg PO TID
	Suspected aspiration	Amox-clavulanate 500 mg PO TID plus/minus Clarithromycin 500 mg PO BID

EMPIRICAL TREATMENT OF SELECT INFECTIONS – ADULT GUIDELINES

Treatment Setting	Modifying Factors	First Line Regimens (7-10 days) Refer to recommendation in pen or cephalosporin allergies
NURSING HOME	± Suspected aspiration	[Amox-clavulanate 500 mg PO TID plus/minus Clarithromycin 500 mg PO BID]
INPATIENT (WARD)	None	[Ceftriaxone 1 g IV q24h plus/minus Clarithromycin 500 mg PO BID (or Azithromycin 500 mg IV daily if unable to take oral therapy)]
	Presumed aspiration *	[Ceftriaxone 1 g IV q24h plus Metronidazole 500 mg IV/PO q8h]

*** Anaerobic coverage for aspiration:**

Anaerobic coverage is clearly indicated only in the classic aspiration pleuropulmonary syndrome in patients with a history of loss of consciousness as a result of alcohol/drug overdose or after seizures in patients with concomitant gingival disease or esophageal motility disorders.

PENICILLIN and/or CEPHALOSPORIN ALLERGY ALTERNATIVES

<p><i>Penicillin-allergic (rash):</i> Cefuroxime axetil 500 mg PO BID</p> <p><i>Severe pen-allergy or cephalosporin allergy:</i> Moxifloxacin 400 mg PO daily</p> <p>Moxifloxacin is an effective agent against community-acquired respiratory pathogens (provided no previous fluoroquinolone use in past 3 months), BUT it should be reserved as 3rd-line agent.</p>

FAILURE OR CRITICAL-CARE TREATMENT SETTING

<p>Refer to BUGS & DRUGS: http://www.bugsanddrugs.ca/ OR Consult with Medical Microbiology / Infectious Disease</p>

SKIN & SOFT TISSUE

Cellulitis

TAKE A SPECIMEN

USUAL PATHOGENS	Recommended Empiric Therapy (7-10 days)
<p><u>Simple Cellulitis</u></p> <p>Group A Streptococci (associated with IV drug use, human bites)</p> <p>Methicillin sensitive Staph aureus (MSSA)</p>	<p><u>Moderate-severe</u></p> <p>Oral Options: Cephalexin 500 mg PO QID</p> <p><i>Severe pen-allergy or cephalosporin allergy (anaphylaxis or angioedema)</i> Clindamycin 600 mg PO TID (less than 50 kg and gastro upset try 300 mg PO QID)</p> <p>Parenteral Options: Cefazolin 1 g IV q8h, OR</p> <p>Cefazolin 2 g IV daily + probenecid PO 1 g daily - 1 dose of probenecid 30 min. prior cefazolin. - outpatient once-daily management and then reassess in 72 hours for efficacy.</p> <p><i>Severe pen-allergy or cephalosporin allergy (anaphylaxis or angioedema)</i> Clindamycin 600 mg IV q8h</p>

Community-acquired methicillin resistant Staph. aureus (CA-MRSA)

To address the problem of CA-MRSA skin & soft-tissue infections within the health authority, the VIHA Antimicrobial Review Subcommittee has developed a **detailed treatment algorithm for adult and pediatric patients** which can be accessed on the VIHA intranet at:

https://intranet.viha.ca/departments/pharmacy/clinical_pharmacy/Documents/infectious_disease/id_infectious_disease_newsletter_algorithm.pdf

Usual Features of SSTI suggestive of CA-MRSA

The index of suspicion should be increased when a patient has 1 or more known epidemiologic risk factors and a consistent clinical presentation with CA-MRSA

1. Risk factors for CA-MRSA infection:
 - ⇒ Intravenous drug use.
 - ⇒ Homelessness / incarceration.
 - ⇒ Aboriginal descent.
 - ⇒ Participation in close contact sports.
 - ⇒ Known close contact with individuals at higher risk.
 - ⇒ History of MRSA infection / colonization.
 - ⇒ Children < 2 years.
 - ⇒ Men who have sex with men.
2. Characteristic clinical presentation:
 - ⇒ Folliculitis, furuncles/carbuncles, abscesses, and/or cellulitis.
 - ⇒ Simultaneous presence of two or more pustules, often at unrelated sites.
 - ⇒ Pustules are often painful and may or may not be associated with cellulitis.

Key Points

- If CA-MRSA suspected, always collect specimen(s) for culture and sensitivity
- Systemic antibiotics are often unnecessary for localized disease with no systemic features.
- There is no clinical data to support combination therapy over monotherapy. Reserve combination therapy for severe infection.
- Rifampin should never be used on its own due to the potential for rapid development of resistance.

Empiric ORAL Therapy for CA-MRSA (7-10 days)
<p>TMP-SMX 1-2 DS tabs PO BID, OR Doxycycline 100 mg PO BID <i>with food</i>, OR Clindamycin 600 mg PO TID (less than 50 kg and gastro upset try 300 mg PO QID) *</p>
<p>If RECURRENT CA-MRSA infection consider adding: Rifampin 600 mg daily or 300 mg PO BID</p>
<p>If Group A Streptococcal (GAS) infection suspected (e.g. rapid onset, lymphangitic streaking, regional lymphadenopathy) and patient NOT already receiving clindamycin, consider ADDING GAS-effective agent:</p> <p style="padding-left: 40px;">Cephalexin 500 mg PO QID, OR Penicillin VK 300 mg PO QID <i>Severe pen-allergy or cephalosporin allergy (e.g. anaphylaxis, angioedema)</i></p> <p style="padding-left: 40px;">Clindamycin PO see above</p>
<p>* Approximately 30% of CA-MRSA strains in VIHA are non-susceptible to clindamycin. Clindamycin should NOT be used as single empiric coverage for moderately severe infections.</p>

Empiric PARENTERAL Therapy for CA-MRSA (7-10 days)
To be used in combination with a single ORAL agent for treatment of moderate/severe infections associated with systemic features
<p>Vancomycin 15 mg/kg IV q12h (assuming normal renal function) Target trough levels of 10-15 mg/L</p>
<p>Consider adding agent that inhibits protein synthesis for life- and/or limb-threatening infections including necrotizing fasciitis, pyomyositis, septic shock, and Staphylococcal toxic shock syndrome:</p> <p style="padding-left: 40px;">Clindamycin 600-900 mg IV q8h</p>

Hospital-acquired methicillin resistant Staph. aureus (**HA-MRSA**)

* Refer to **BUGS & DRUGS**: <http://www.bugsanddrugs.ca/> OR Consult with **Medical Microbiology / Infectious Disease**

URINARY TRACT

Refer to VIHA Algorithm for the empiric treatment of Urinary Tract Infection and Asymptomatic Bacteriuria on the VIHA Intranet:

https://intranet.viha.ca/departments/pharmacy/clinical_pharmacy/Pages/infectious_disease.aspx

KEY MESSAGES:

- E. coli is the most common pathogen in urinary tract infections..
- E. coli has a 77% sensitivity to TMP/SMX, ciprofloxacin, and norfloxacin across British Columbia.

DEFINITIONS

Short-term Urinary Catheter

Indwelling catheter for less than 30 days.

Long-term (chronic) Urinary Catheter

Indwelling catheter greater than 30 days.

Catheter-Associated Bacteriuria

Patients with indwelling urinary catheters (particularly long-term catheters) will inevitably develop bacteriuria and cloudy urine.

Dipstick Urine Test

- Positive nitrites indicates the presence of coliforms.
- Positive leucocytes indicates pyuria.
- A **negative** dipstick test makes UTI unlikely (but does **NOT** definitely exclude it).
- A **positive** dipstick test does not indicate a symptomatic UTI nor the need for antibiotic therapy in the absence of localizing features in the genitourinary tract.

Asymptomatic Bacteriuria

- Onset of smelly, and/or turbid urine.
- No fever.
- No genitourinary signs, or some stable genitourinary signs, e.g. incontinence.
- Asymptomatic bacteriuria is NOT associated with incontinence, hypertension, or decreased renal function in the elderly.
- **Routine dipstick tests are not necessary.**
- Antimicrobial therapy is generally indicated ONLY for **treatment in pregnancy and prophylaxis for TURP / urologic surgery. Definitive antimicrobial therapy based on urine C&S results.**

Pregnancy

- Post treatment urine culture and monthly screen for remainder of pregnancy

Common Antimicrobial Regimens Safe in Pregnancy (3 days)
<p>Amoxicillin 500 mg PO TID, OR</p> <p>Cephalexin 500 mg PO QID, OR</p> <p>Cefixime 400 mg PO daily, OR</p> <p>Nitrofurantoin (MACROBID) 100 mg PO BID</p> <p>- Avoid near term pregnancy: greater than 35 weeks</p> <p>- Avoid if GFR less than 60 ml/min</p> <p>OR</p> <p>TMP/SMX 1 DS tab PO BID</p> <p>- Avoid in 1st trimester and last 6 weeks of pregnancy</p>

All Other Patients

- Increase fluid intake if possible.
- **Treatment with antibiotics is generally NOT indicated.**

Cystitis

Empiric therapy targeting the most likely urinary tract pathogens should be initiated when urinalysis results and symptomatology support the diagnosis of cystitis, even when C&S pending.

Signs and Symptoms of Suspected UTI

- Dysuria in combination with frequency, urgency, suprapubic pain, and/or hematuria
- Usually in the absence of vaginal symptoms
- Pyuria on the routine analysis
- Nitrite positive (for gram negatives)

Presence of Additional Signs & Symptoms (SEE Pyelonephritis)

- Fever (temperature ≥ 38.5 C)
- Flank pain
- Abdominal or pelvic pain
- Nausea/vomiting
- Costovertebral tenderness
- Presence of white cell casts on urinalysis
- Usually in the absence of vaginal symptoms
- Pyuria on the routine analysis
- Nitrite positive (for gram negatives)

Urine Collection

- When cystitis is suspected, a midstream urine (MSU) specimen should be collected for routine and microscopic urinalysis, as well as C&S.
- *Catheterized patients* – replace catheter and collect specimens through a clean catheter.

Complicating Factors

- Women greater than 55 years
- Men
- Symptoms lasting greater than 7 days
- Diabetes Mellitus
- Structural abnormality of urinary tract
- Spinal cord injury
- Multiple sclerosis
- Pregnancy
- Chronic catheterization
- Recurrent UTI

Uncomplicated Cystitis

USUAL PATHOGENS	Recommended Empiric Therapy
E. coli S. saprophyticus Other entero-bacteriaceae	Nitrofurantoin (MACROBID) 100 mg PO BID for 5 days - Avoid near term pregnancy: greater than 35 weeks - Avoid if GFR less than 60 ml/min OR TMP/SMX 1 DS tab PO BID for 3 days - Avoid in 1st trimester and last 6 weeks of pregnancy OR Cefixime 400 mg PO daily for 3 days

Complicated Cystitis

Tailor therapy once C&S results obtained and treat for a total of 7 days. For structural abnormality of urinary tract or for catheterized patients, treat for 10-14 days.

USUAL PATHOGENS	Recommended Empiric Therapy
Enterobacteriaceae Enterococcus spp. Group B Streptococci	Amoxicillin-clavulanate 500 mg PO TID OR TMP/SMX 1 DS tab PO BID - Avoid in 1st trimester and last 6 weeks of pregnancy OR Cefixime 400 mg PO daily

Catheterized Patients - Comments

In the chronically catheterized patient with symptomatic UTI, the catheter should be changed and *then* a urine specimen obtained (through the clean catheter), as indwelling catheters are often colonized with bacteria.

Cystitis in Males - Comments

First-episode cystitis is usually treated for 7 days while recurrent cystitis is treated

Diabetes Mellitus - Comments

Patients with diabetes are predisposed to infection with group B Streptococci; therefore a beta-lactam antibiotic may be preferred.

Recurrent or Relapsing Cystitis

More than 90% of cases of recurrence are due to reinfection (with different organism or strain) after 2-4 weeks following treatment. Relapse (with the same organism and strain) is usually within 2 weeks following treatment. These differences can be used to some extent to predict the bacteria involved with the antibiotic regimen to use.

Pyelonephritis

- Collect blood cultures X 2 (in addition to urine C&S)
- Tailor therapy once C&S results obtained and step down to PO treatment when appropriate

Uncomplicated Pyelonephritis

- Treat for total **10-14 days**

USUAL PATHOGENS	Recommended Empiric Therapy
E. coli Enterobacteriaceae S. saprophyticus	<p>IV Options Ceftriaxone 1 g IV q24h OR Gentamicin 7 mg/kg q 24h* <i>*GFR should be greater than or equal to 60 ml/min</i></p> <p>Oral Options TMP/SMX 1 DS tab PO BID - Avoid in 1st trimester and last 6 weeks of pregnancy OR Cefixime 400 mg PO daily</p>

Complicated Pyelonephritis

- Treat for total **14 days** and conduct follow-up urine C&S.

USUAL PATHOGENS	Recommended Empiric Therapy
E. coli Enterobacteriaceae S. saprophyticus Pseudomonas spp Enterococcus spp Group B Streptococci	<p>IV Options [Ceftriaxone 1 g IV q24h + Ampicillin 1 g IV q6-12h] OR [Gentamicin 7 mg/kg IV q 24h* + Ampicillin 1 g IV q6h] <i>* GFR should be greater than or equal to 60 ml/min</i></p> <p>Oral Options Amoxicillin-clavulanate 500 mg PO TID OR TMP/SMX 1 DS tab PO BID - Avoid in 1st trimester and last 6 weeks of pregnancy OR Cefixime 400 mg PO daily</p>

ACKNOWLEDGEMENT & CONTACTS

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 - Dr. Pamela Kibsey (Medical Microbiology)
 - Dr. Eric Partlow (Infectious Disease)
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 - Dr. Martin Wale (Quality, Research and Safety)

CONTACT INFORMATION

INFECTIOUS DISEASES SERVICE

	OFFICE LOCATION	OFFICE NUMBER
Dr. David Forrest	Nanaimo Regional General Hospital	Switchboard 250-755-7691
Dr. Wayne Ghesquiere	Victoria	250-370-7717
Dr. Eric Partlow	Victoria	250-370-7717

MICROBIOLOGY SERVICES

For inquiries about a patient's Microbiology results, please phone the Laboratory Call Center at (250) 370-8355 or 1-866-370-8355.

For other inquiries related to Microbiology, please call or FAX:

RJH Lab Microbiology Assessments: (250) 370-8720

Microbiology FAX: (250) 519-1628

Mycobacteriology (TB) and Mycology: (250) 519-1620

Medical Microbiologists:

Dr. Pam Kibsey (250) 519-1626

Dr. John Galbraith (250) 370-8755

Dr. James Hutchinson (250) 519-1941

On Call Medical Microbiologist:

May be reached by contacting the Laboratory Call Center at 250-370-8355 or 1-866-270-8355

