

**Case 4**  
**The Effect of *Listeria monocytogenes* on the Body System**

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## Case 4

Carry, a 29-year-old woman, is 32 weeks pregnant with her first child.

As a foodie, she loves trying different gourmet restaurants in Vancouver. A new “farm-to-table” restaurant has opened and she gets a bunch of friends to go out for a nice dinner. Carry orders a toasted pecan, strawberry and mature goat cheese salad to start.

She knows that, in pregnancy, she should not eat raw or unpasteurized cheeses but cannot help the temptation - she’s heard that this is the best salad in Vancouver. A few days later, she develops mild diarrhea and night sweats that she thinks will eventually pass, but the following day she has a fever so she goes to the emergency department where she has blood and stool cultures collected. The blood cultures turn positive for *Listeria monocytogenes*. She wonders what effect this will have on her unborn baby.

# INTRODUCTION

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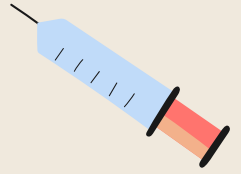
*Listeria monocytogenes* is a gram positive intracellular bacteria (1). It is a facultative anaerobe. It can cause serious infection to neonates, the immunocompromised, and the elderly (1)





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# Signs and Symptoms




## Exhibited by Patient:

- Mild diarrhea, night sweats, fever

## Other signs and symptoms that are not presented:

- Fatigue (2)
- Headache (2)
- Nausea and vomiting (2)

## Severe symptoms:

- Confusion (2)
- Loss of balance (2)
- Convulsions (2) 
- Stiff neck (2)



<https://www.istockphoto.com/illustrations/pregnancy-constipation>

# HISTORY OF PRESENT ILLNESS (3)



## LOCATION (3)

Night sweats are all throughout the body. Mild diarrhea is in the gut.

## QUALITY (3)

Quality of the symptoms are mild. However, It is possible that her fever can escalate to severe.



## TIMING (3)

Symptoms started to develop a few days after eating the unpasteurized cheese.

## CONTEXT (3)

Patient went to a restaurant and ate a salad with unpasteurized cheese.



## SEVERITY (3)

Patient didn't specify pain, but they probably felt discomfort from the night sweats and mild diarrhea.

## DURATION (3)

Symptoms developed a few days after she had food and persist until the following day.



## + 02

# 2 Major Clinical Syndromes

## Non invasive

- It is the mild form of the disease and it mainly infects healthy people (4)
- Incubation is a few days (4)
- Symptoms are diarrhea, headache, and muscle pains (4)
- It can result in febrile gastroenteritis (4)
  - Affecting the gastrointestinal system



## Invasive

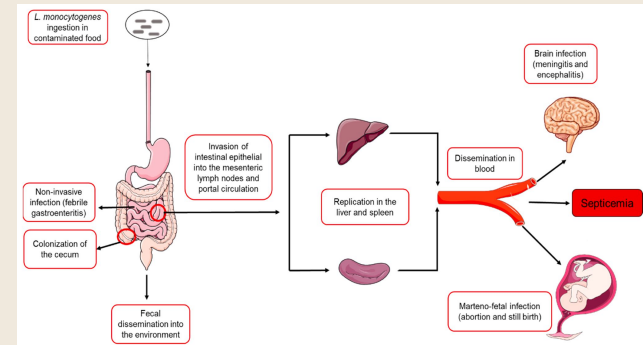
- It is the severe form of the disease that will infects high risk groups (4)
  - Eg. pregnant women, elderly, infants, etc. (4)
- Incubation is typically 1-2 weeks, but can be has high as 90 days (4)
- Symptoms are fever and muscle pain, but this can escalate to more serious diseases (4)

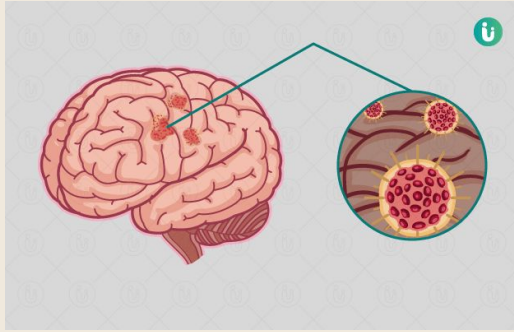
# Invasive *Listeria monocytogenes*

- Invasive *L. monocytogenes* can spread throughout the body and infect various tissues (5)
- Once a host is infected the bacteria will move from the gut into the mesenteric lymph nodes, where it will target the spleen and liver (5)
  - If the infection becomes out of control, the bacteria will move through the
  - bloodstream and it will be able to spread into other organs and body systems (5)

## Lymphatic System

- After a patient is infected, many neutrophils producing IFN- $\gamma$  will accumulate in the spleen and blood (6,7).
  - IFN- $\gamma$  stimulates the clearance of bacteria via neutrophils, resulting in the inhibition of laminin-induced neutrophil apoptosis and spleen damage (7)

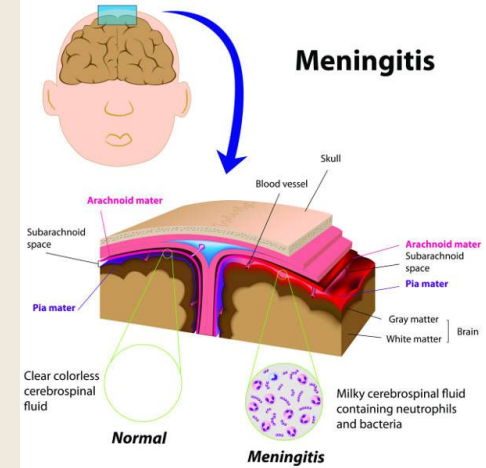




<https://www.myupchar.com/en/disease/encephalitis>

## Central Nervous System

- *L. monocytogenes* can invade the blood brain barrier (BBB) by manipulating the host immune cell responses so it can pass undetected (8)
  - This will result in meningitis or/and encephalitis (9)

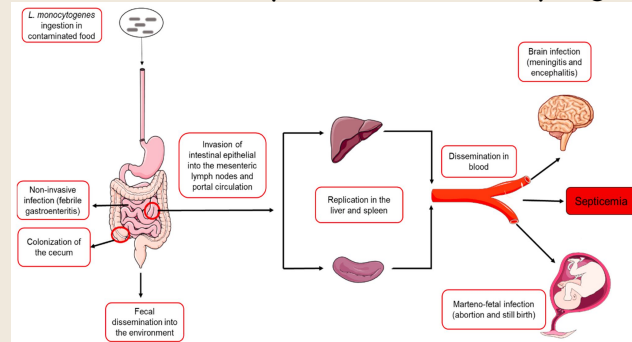


<https://www.headway.org.uk/about-brain-injury/individuals/types-of-brain-injury/meningitis/>

## Placenta

- Once *L. monocytogenes* is in the bloodstream, it can spread to the placenta of pregnant women (10)
  - This can lead to fetal resorption, a miscarriage, or a stillbirth (10)

Figure 1: Infection cycle of *L. monocytogenes*



<https://www.mdpi.com/2076-2607/10/8/1522>





03

# ANTIBIOTICS



## Ampicillin (11)

Main antibiotic to treat *Listeria* (11)

It will inhibit the synthesis of the bacterial cell wall (12)

- It will attach and inactivate to penicillin-binding proteins (PBPs) (12)
- Result in the inhibition of cell of peptidoglycan synthesis (12)



## Gentamicin (13)

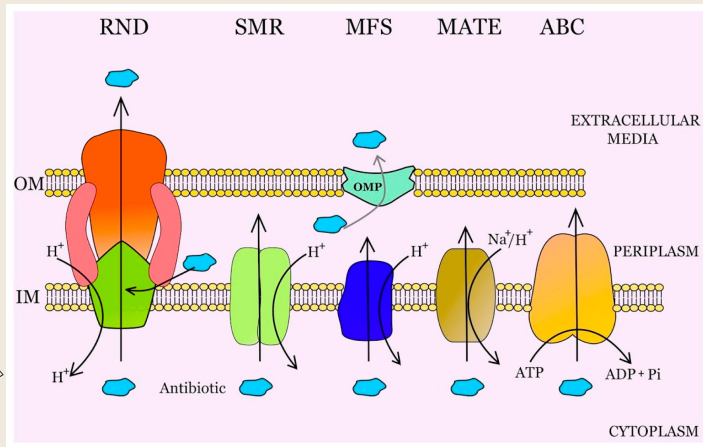
Inhibit the synthesis of proteins in the bacteria (14)

- Bind to the 16s rRNA at the 30s ribosome; subunit (14)
- Result in the disruption of mRNA translation (14)

# Why do cephalosporins not work on *Listeria*?

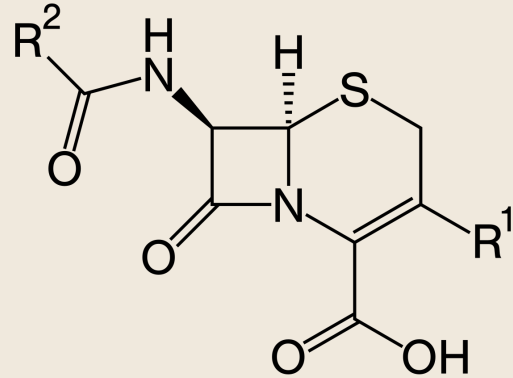
- Resistance to cephalosporins is encoded by a bacterial resistome (15)
  - It will encode for an efflux pump that will pump out the antibiotic (15)
- Resistance to cephalosporins is also a result of the lack of Penicillin Binding Proteins “PBPs” that bind (15)
  - These are inhibited by  $\beta$ -lactam antibiotics (15)

Figure 2: Multidrug Efflux Pump



<https://www.mdpi.com/2076-2607/4/1/14>

Figure 3: Structure of Cephalosporin



<https://en.wikipedia.org/wiki/Cephalosporin>

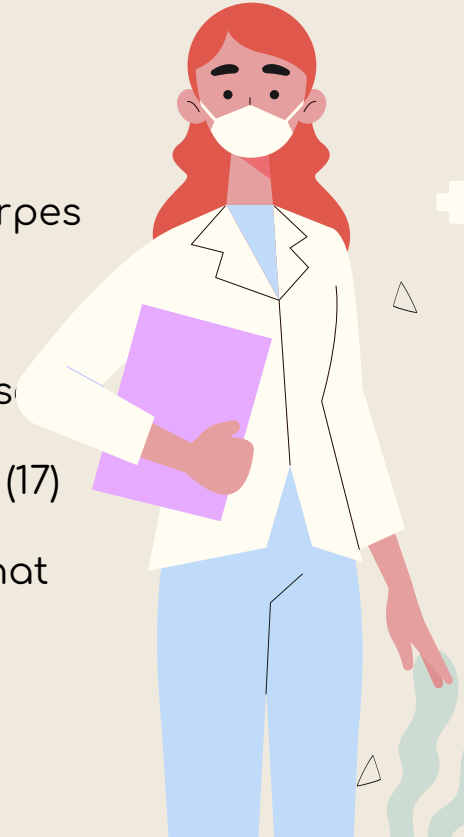
## What is a ToRCH/SCoRCH infection? Why are they important?

ToRCH Infections are congenital infections that include toxoplasmosis, “other”, rubella, Cytomegalovirus, and herpes (16)

- These infections are caused by *Toxoplasma gondii*, *Treponema pallidum*, Hepatitis B virus, Rubella virus, cytomegalovirus, and herpes virus simplex (16)

SCoRCH infections include syphilis, cytomegalovirus, “other”, rubella, toxoplasmosis, chickenpox, herpes simplex virus, and blood-borne viruses (17)

- It gives clinicians awareness of the high risk of congenital syphilis (17)
  - It also considers: zika, parvovirus, and enterovirus (17)
- It is a diagnostic approach that describes signs present in infants that have congenital infection, details serological testing, and direct diagnostics of the infant (17)

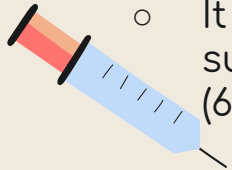






## Why are pregnant women at higher risk of *Listeria* ?

- They have lower levels of cellular immunity as a result of higher levels of progesterone (20)
- Low levels of cellular immunity will affect CD8 and CD4 T cells fighting intracellular pathogens (6)
  - CD8 T cells get rid of infected cells and CD4 T cell will intensify the response of other immune cells (6)
  - If the cells are weak, then it will be more difficult for an infection to be cleared (6)
  - It will also increase the patient's susceptibility to contraction the infection (6)



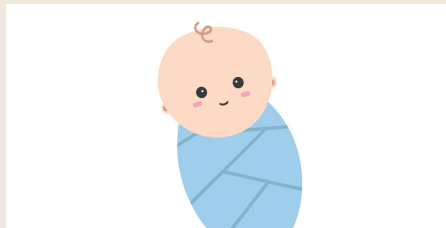
[https://www.freepik.com/premium-vector/pregnant-woman-suffers-from-nausea-toxic-osis-during-pregnancy\\_21217645.htm](https://www.freepik.com/premium-vector/pregnant-woman-suffers-from-nausea-toxic-osis-during-pregnancy_21217645.htm)

# What are other high risk groups for invasive disease?

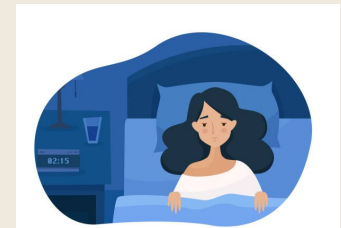
- Other groups that are high risk are adults over the age of 65, newborns, and people who are immunocompromised (21)
  - Adults over 65 (22)
    - It is more difficult food their immune system to clear the pathogen (21)
  - Newborns (23)
    - Have weaker immune systems, so they are more susceptibility to contracting the disease (23)
  - Immunocompromised (23)
    - The body's immune response to *L. monocytogenes* is dependent on our cellular immune response (T cells) (23)
    - If this response is suppressed, this makes patients more susceptible (23)



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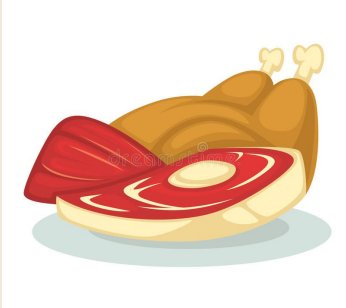


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<https://www.istockphoto.com/illustrations/sick-person>

# How should one prevent exposure to listeria?



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- Cook raw food thoroughly, eg. chicken, beef, pork (25)
- Thoroughly wash vegetables before eating (25)
- Avoid unpasteurized milk and foods containing raw milk (25)
- Separate uncooked meat from vegetables and cooked foods (25)
- Clean hands, knives, cutting boards after preparing uncooked foods (25)



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<https://www.dreamstime.com/illustration/vegetables.html>



<https://www.istockphoto.com/search/2/image?mediatype=illustration&phrase=row+milk>

# References

1. Rogalla D, Bomar PA. 2022. *Listeria monocytogenes* - statpearls - NCBI bookshelf. National Library of Medicine .
2. Center for Food Safety and Applied Nutrition. *Listeria* (listeriosis). US Food and Drug Administration. FDA.
3. History of present illness. American College of Cardiology.
4. Listeriosis. World Health Organization. World Health Organization.
5. Tucker JS, Cho J, Albrecht TM, Ferrell JL, D'Orazio SE. 2023. Egress of *Listeria monocytogenes* from mesenteric lymph nodes depends on intracellular replication and cell-to-cell spread. *Infection and Immunity*.
6. Zenewicz LA, Shen H. 2007. Innate and adaptive immune responses to *Listeria monocytogenes*: A short overview. *Microbes and Infection* 9:1208-1215.
7. Wang G, Lin A, Han Q, Zhao H, Tian Z, Zhang J. 2018. IFN- $\gamma$  protects from apoptotic neutrophil-mediated tissue injury during acute *Listeria monocytogenes* infection. *European Journal of Immunology* 48:1470-1480.
8. Drevets DA, Leenen PJ, Greenfield RA. 2004. Invasion of the central nervous system by intracellular bacteria. *Clinical Microbiology Reviews* 17:323-347.
9. Ghosh P, Higgins DE. 2018. *Listeria monocytogenes* infection of the brain. *Journal of Visualized Experiments*.
10. Mateus T, Silva J, Maia RL, Teixeira P. 2013. Listeriosis during pregnancy: A public health concern. *ISRN Obstetrics and Gynecology* 2013:1-6.
11. Karen B Weinstein MD. 2022. *Listeria monocytogenes* infection (listeriosis) medication. *Antibiotics*. Medscape.
12. Ampicillin. National Center for Biotechnology Information PubChem Compound Database. U.S. National Library of Medicine.
13. Drevets DA, Canono BP, Leenen PJ, Campbell PA. 1994. Gentamicin kills intracellular *Listeria monocytogenes*. *Infection and Immunity* 62:2222-2228.
14. Chaves BJ, Tadi P. Gentamicin - statpearls - NCBI bookshelf. National Library of Medicine.
15. Krawczyk-Balska A, Markiewicz Z. 2015. The intrinsic cephalosporin resistance of *Listeria monocytogenes* in the context of stress response, gene regulation, pathogenesis and Therapeutics. *Journal of Applied Microbiology* 120:251-265.
16. Jaan A, Rajnik M. 2022. Torch Complex - StatPearls - NCBI Bookshelf. National Library of Medicine.
17. Penner J, Hernstadt H, Burns JE, Randell P, Lyall H. 2020. Stop, think scotch: Rethinking the traditional 'torch' screen in an era of re-emerging syphilis. *Archives of Disease in Childhood* 106:117-124.
18. Torch panel. TORCH Panel - Health Encyclopedia - University of Rochester Medical Center.
19. Vázquez-Boland JA, Kryptou E, Scortti M. 2017. *Listeria* placental infection. *mBio* 8.
20. Mateus T, Silva J, Maia RL, Teixeira P. 2013. Listeriosis during pregnancy: A public health concern. *ISRN Obstetrics and Gynecology* 2013:1-6.
21. 2022. People at risk. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention.
22. 2022. People at risk - older adults. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention.
23. 2022. People at risk - pregnant women and newborns. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention.
24. Who is most at risk of becoming ill with listeria? Marler Clark.
25. Preventing foodborne illness: Listeriosis. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention.