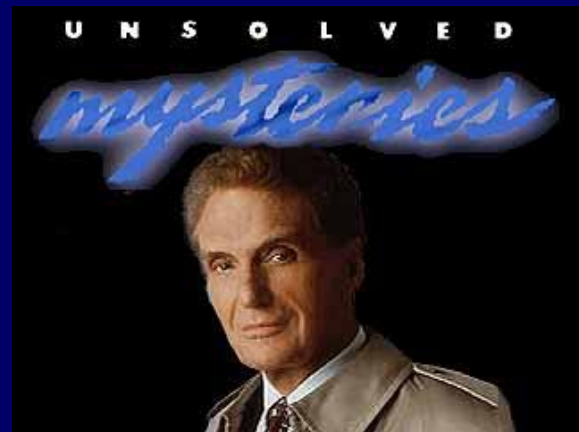
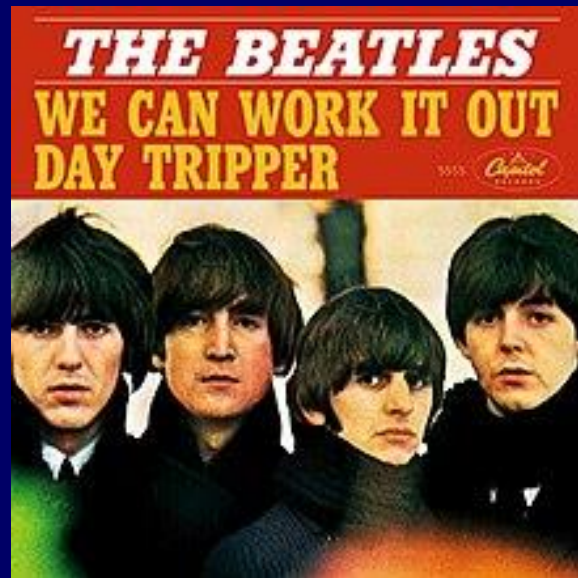


We Can Work it Out

23-year-old Female with Unexpected "Bowel Movement"



WHAT IS IT?



Erik Munson
Marquette University
Milwaukee, Wisconsin

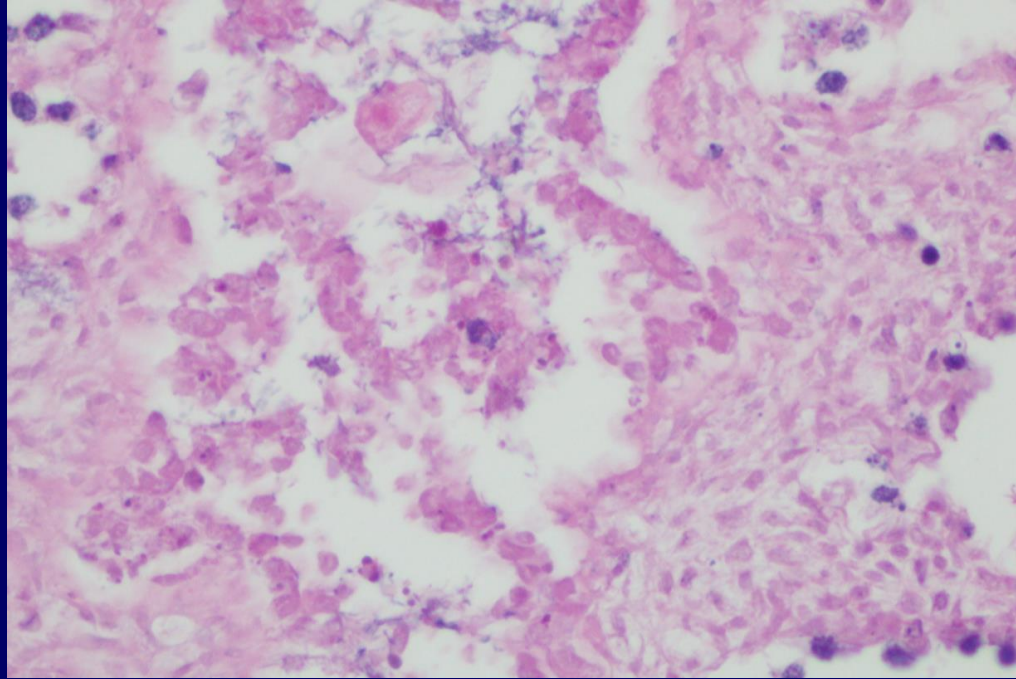
PAST MEDICAL/SOCIAL HISTORY

- Diagnosis of systemic lupus erythematosus two months previously
- SLE complicated by lupus nephritis
- Active smoker
- Current medications:
 - Methyldopa (HTN; chemical reduction)
 - Hydralazine (HTN; vasodilator)
 - Furosemide (HTN; diuretic)
 - Verapamil (chest pain; calcium-channel blocker)
 - Prednisone (lupus; corticosteroid)
 - Azathioprine (kidney rejection; immunosuppressant)

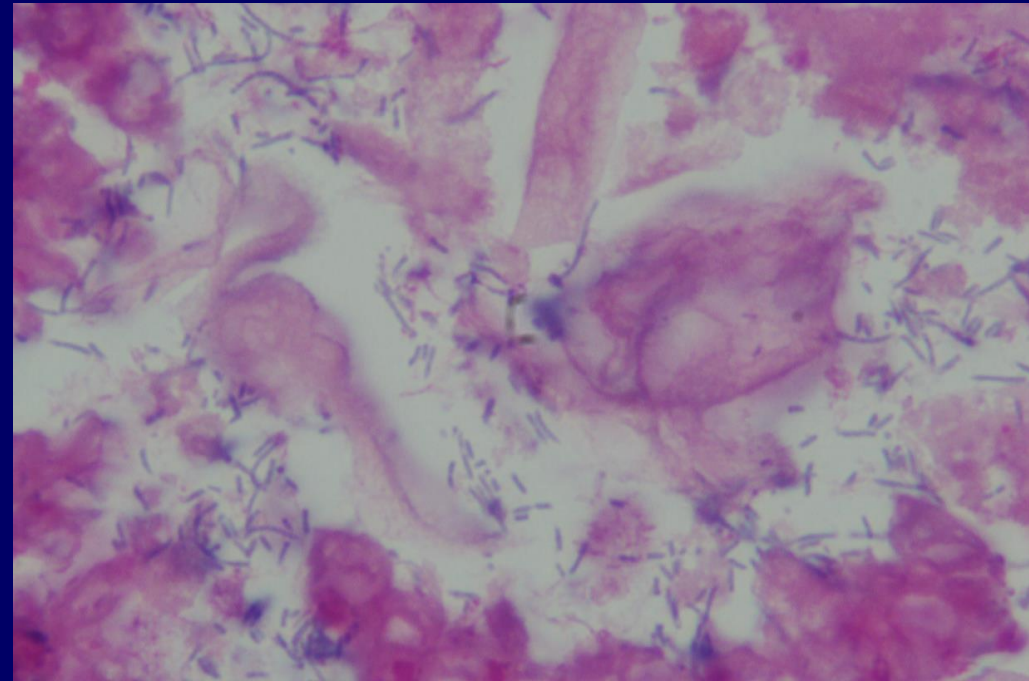
PRESENTING CONDITION

- At home, felt pressure similar to needing to have a bowel movement
- Went to bathroom, noticed fetal legs hanging from vagina
- EMTs did not observe fetal heart tones
- Fetus delivered at hospital; placenta removed by dilation and curettage

HISTOLOGY (FETAL LUNG)

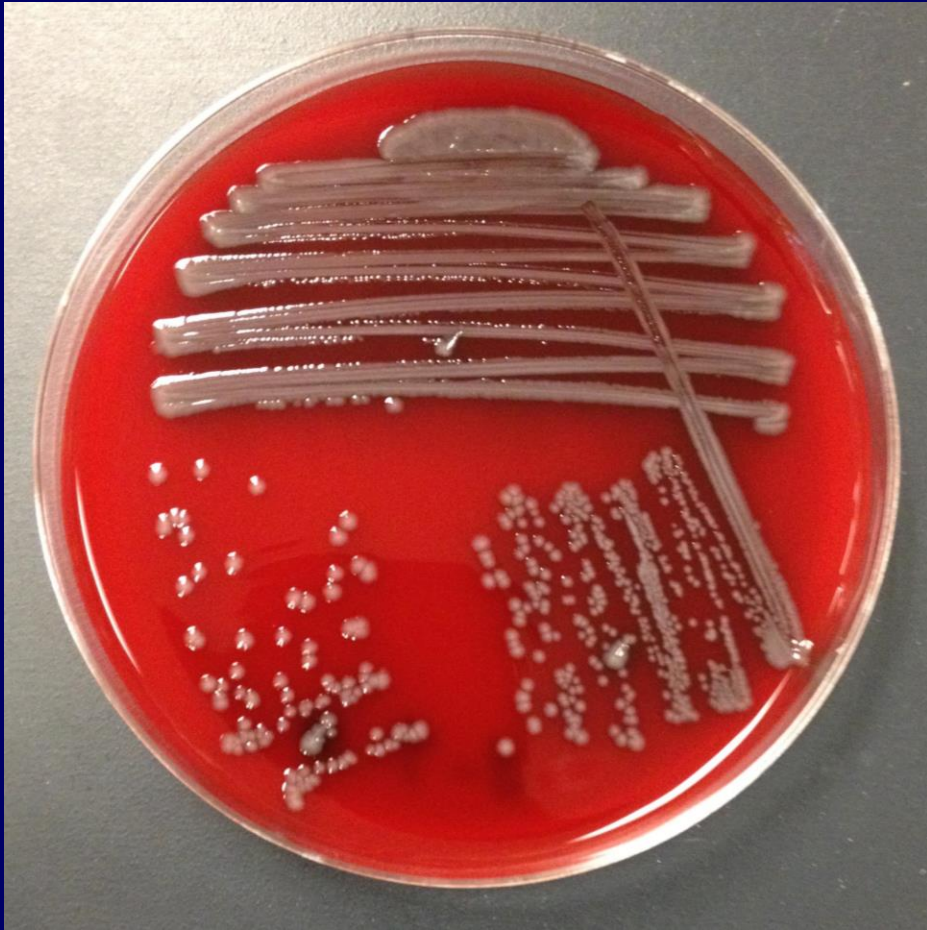


Hematoxylin & Eosin
(400X total)



Hematoxylin & Eosin
(1000X total)

ORGANISM RECOVERED (Pure)



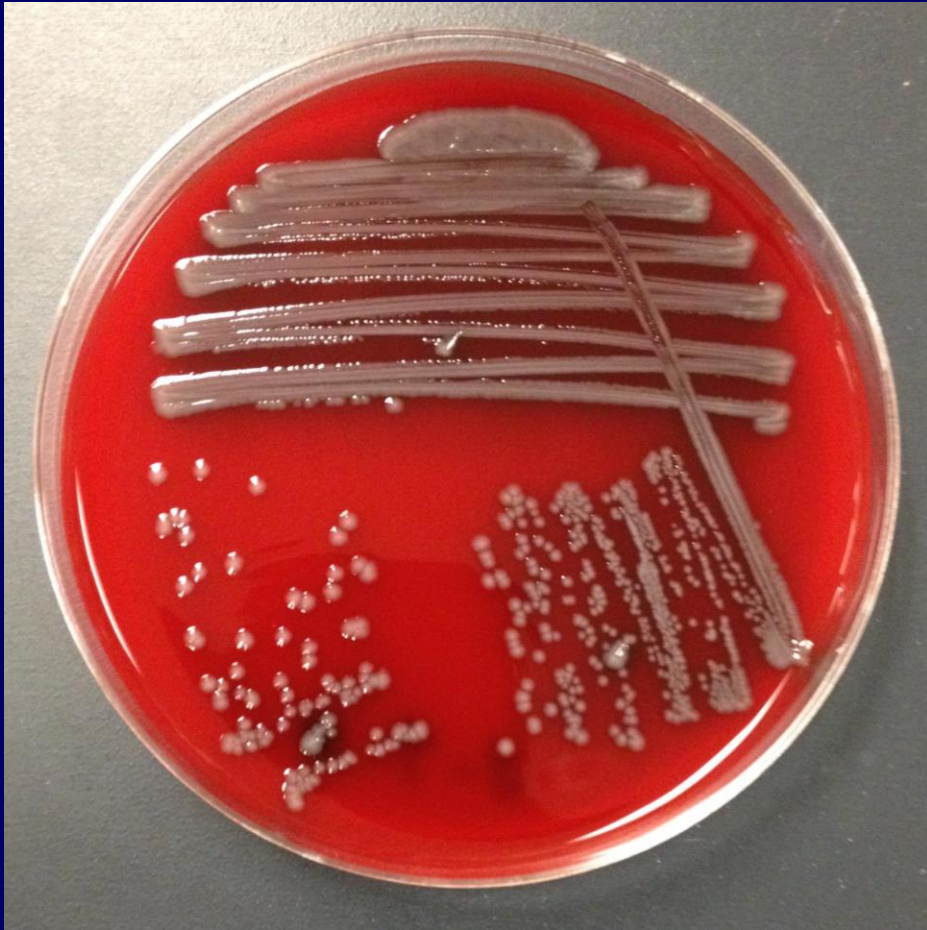
37°C, 5% CO₂



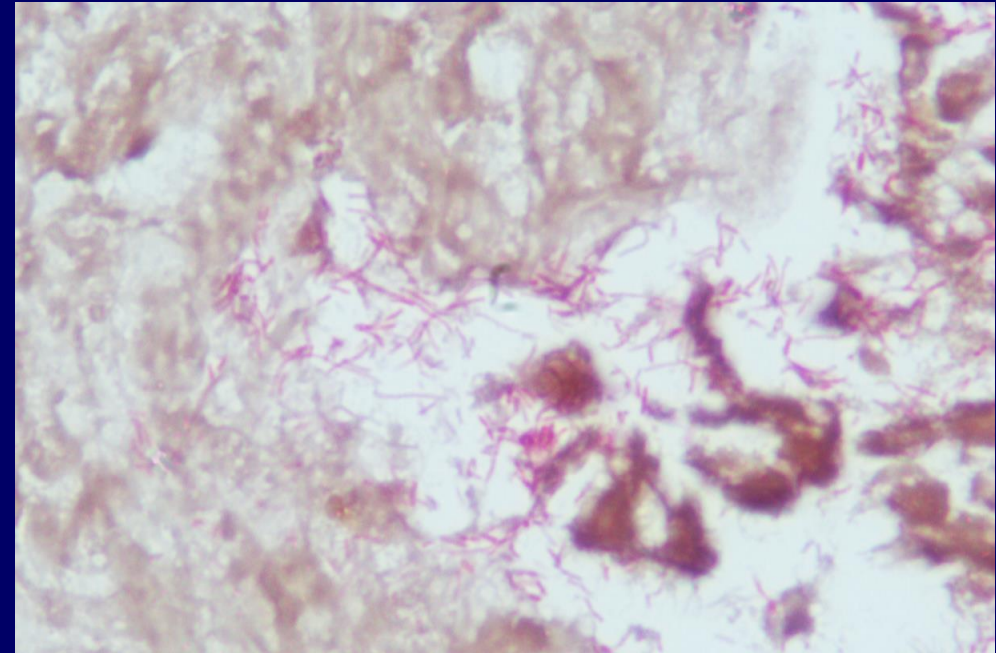
The audience is going to ID this one!



ORGANISM RECOVERED (Pure)



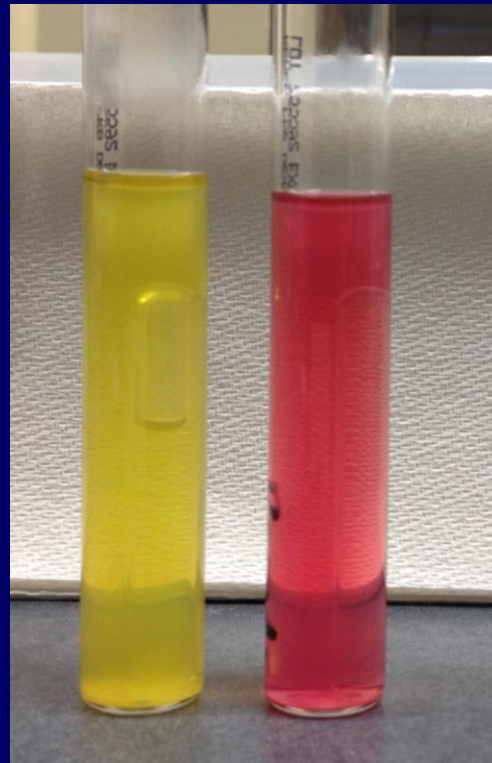
37°C, 5% CO₂



Gram
(1000X total)

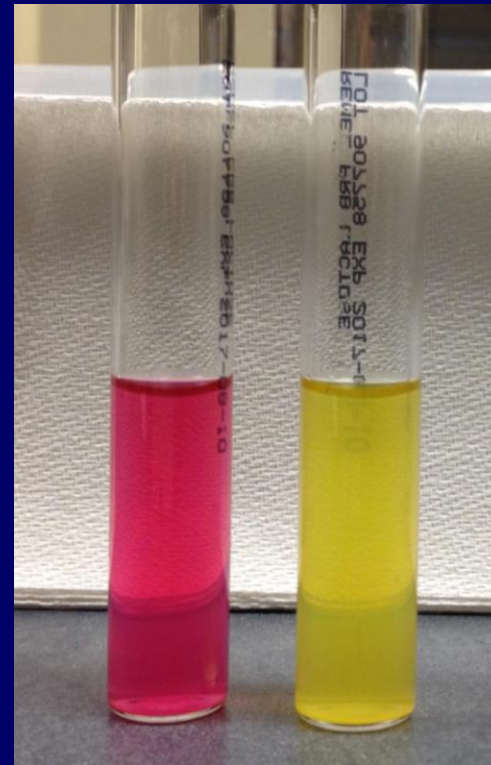
FERMENTATION TUBES

Glucose



Unknown

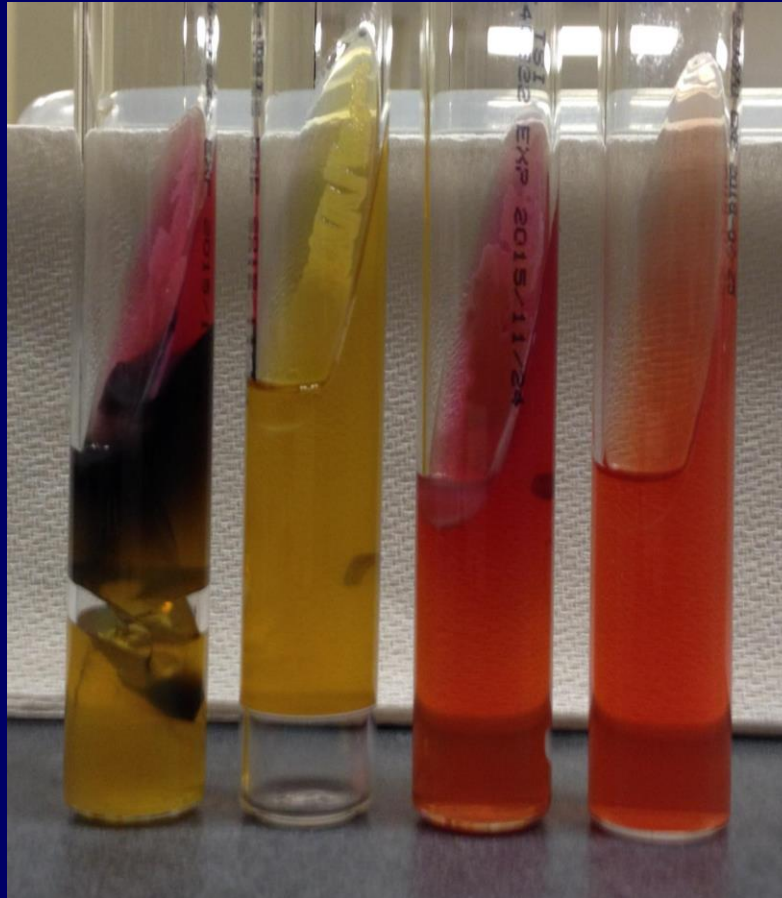
Lactose



Unknown

FIRST-LEVEL SCREENING

Triple Sugar Iron

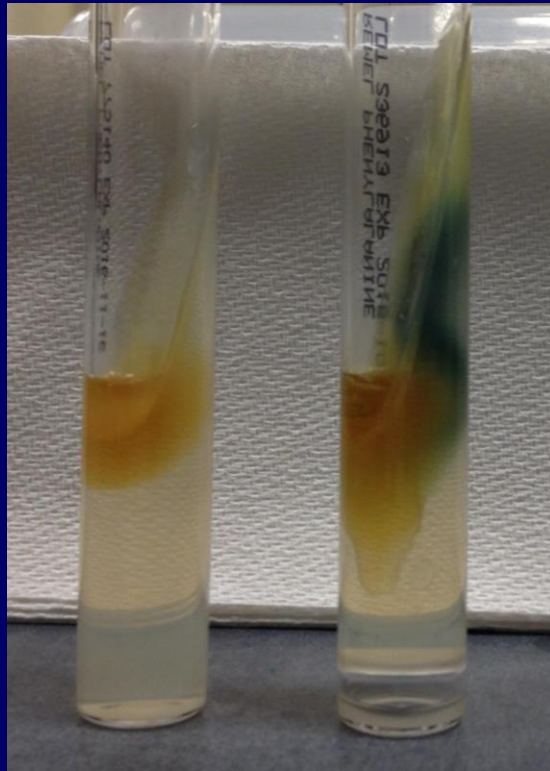


Unknown

Non-
inoculated

SECOND-LEVEL SCREENING

Phenylalanine



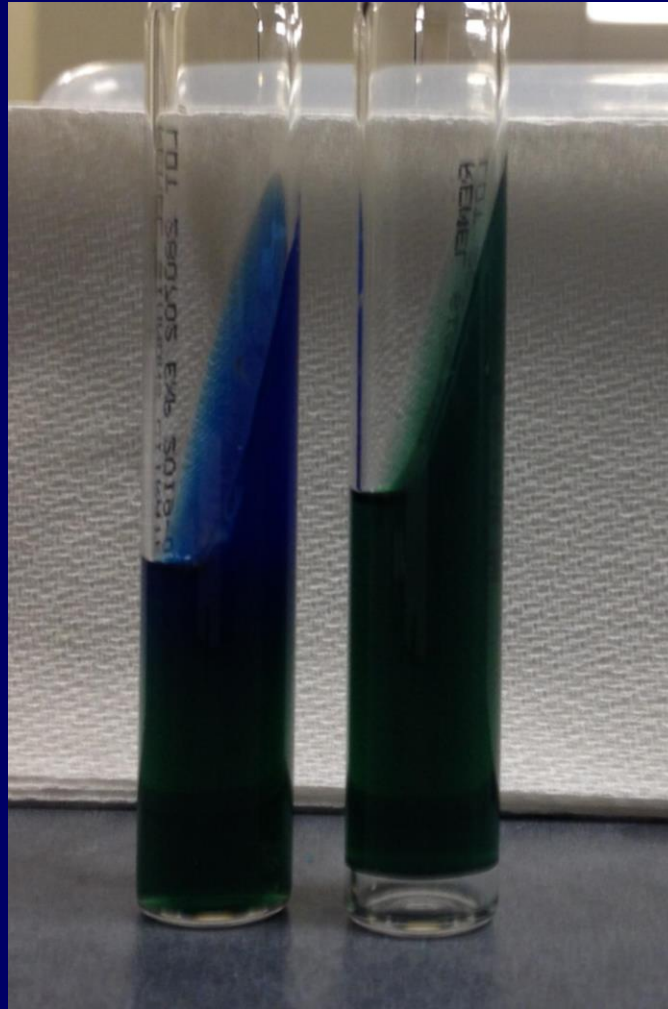
Unknown

Urease



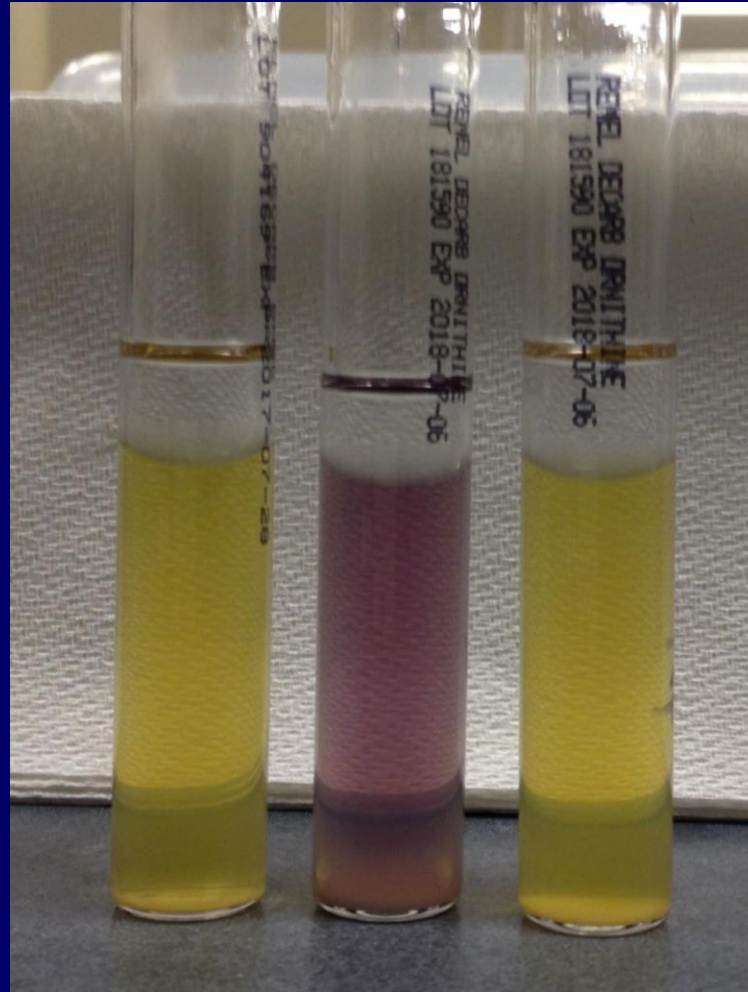
Unknown

CITRATE



Unknown

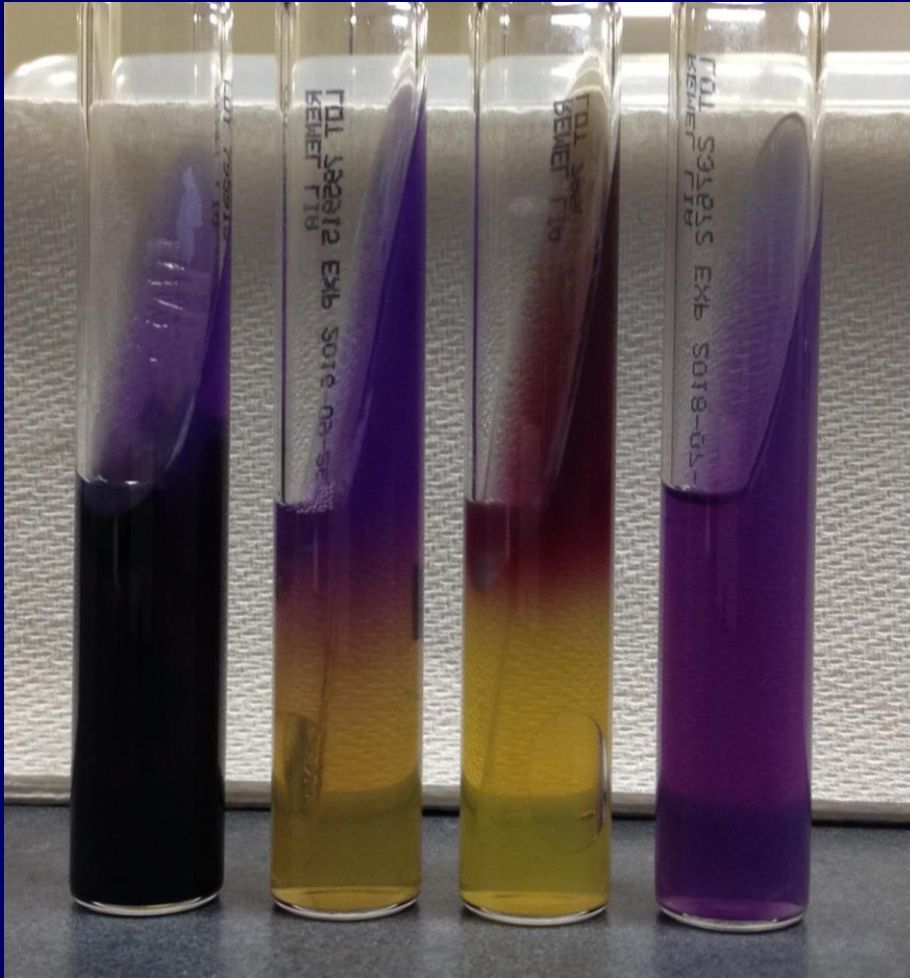
DECARBOXYLASES (MOELLER)



B
A
S
E

Unknown

DECARBOXYLASES (LIA)



Unknown

Non-
inoculated



deamination yields α -ketocarboxylic acid



decarboxylation yields cadaverine

You Make the Call



Salmonella NOMENCLATURE

- Strict taxonomy

Salmonella enterica (six subspecies)

Salmonella bongori

Salmonella NOMENCLATURE

- Strict taxonomy

 - Salmonella enterica* (six subspecies)

 - Salmonella bongori*

- Clinical microbiology laboratory (serogrouping)

 - Somatic, capsular (why???) antigens

 - 95% of human infections due to A, B, C1, C2, D, E

Salmonella NOMENCLATURE

- Strict taxonomy

 - Salmonella enterica* (six subspecies)

 - Salmonella bongori*

- Clinical microbiology laboratory (serogrouping)

 - Somatic, capsular (why???) antigens

 - 95% of human infections due to A, B, C1, C2, D, E

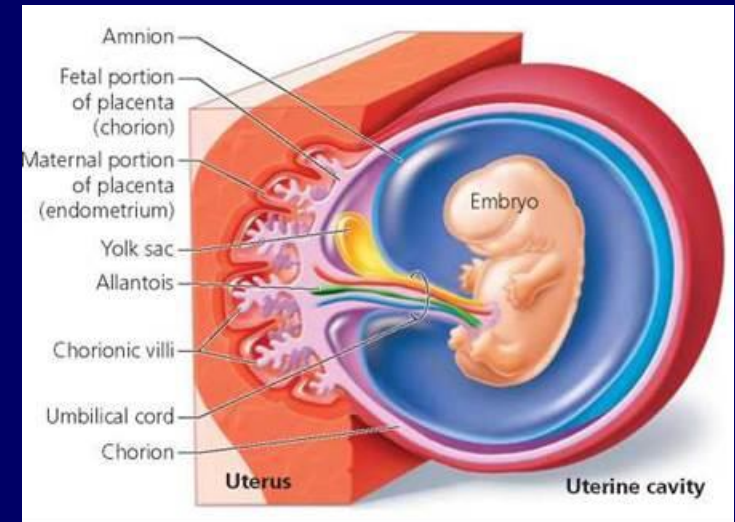
- Public health laboratory (serotyping)

 - Somatic, capsular, flagellar, molecular, sequencing
1000s of serotypes for *S. enterica* subsp. *enterica*

 - Salmonella* serotype Enteritidis (serogroup D1)

CHORIOAMNIONITIS

- a.k.a. intra-amniotic infection
- Inflammation of amnionic or chorionic membranes (PMNs, monocytes) usually due to bacterial infection
- Autopsy also noted:
 - placental infarction
 - acute villitis
 - distal villous hypoplasia



CHORIOAMNIONITIS FREQUENCY

TABLE 1

Frequency of chorioamnionitis according to gestational age at delivery

Weeks of gestation	Chorioamnionitis, n	Total no. of patients	Percentage
21–24	17	18	94.4
25–28	19	48	39.6
29–32	34	96	35.4
33–36	53	497	10.7
37–40	233	6139	3.8
41–44	36	707	5.1
TOTALS	392	7505	5.2

Modified from Russell P.²

Kim. Acute inflammatory lesions of the placenta. Am J Obstet Gynecol 2015.

CHORIOAMNIONITIS ORIGIN

- Ascending

 - Most cases of chorioamnionitis

 - Prolonged rupture of membranes

 - Labor in patients with multiple vaginal exams

 - Organisms with vaginal niche

 - Organisms with intestinal niche

CHORIOAMNIONITIS ORIGIN

- Ascending

Most cases of chorioamnionitis

Prolonged rupture of membranes

Labor in patients with multiple vaginal exams

Organisms with vaginal niche

Organisms with intestinal niche

S. agalactiae and *E. coli*
bacteremia can complicate
chorioamnionitis

CHORIOAMNIONITIS ORIGIN

- Ascending

- Rare causes

 - Diagnostic amniocentesis

 - Intrauterine blood transfusion

 - Percutaneous umbilical blood sampling

*S. agalactiae and E. coli
bacteremia can complicate
chorioamnionitis*

CHORIOAMNIONITIS ORIGIN

- Ascending

- Rare causes

- Transplacental hematogenous

Listeria monocytogenes
Haemophilus influenzae

S. agalactiae and *E. coli*
bacteremia can complicate
chorioamnionitis

Salmonella AND PREGNANCY

- *Salmonella* spp. infection rate at delivery (0.2%) similar to infection rate in general population

J. Hosp. Infect. **10**: 67-72; 1987

- Enteric fever during pregnancy

Miscarriage
Stillbirth

Pre-term labor
Neonatal sepsis

Lancet **1**: 1491-1493; 1905

- Fetal loss rates ~80% for untreated typhoid

Obstet. Gynecol. **71**: 711-714; 1988

Salmonella enterica serotype Paratyphi

- Review of three vertical transmission cases in India (since 2007)

Transplacental spread of organism

Maternal bacteremia during labor

Unintended fecal contamination of birth canal

Pediatr. Infect. Dis. J. **13**: 774-776; 1994

- One case of sepsis (survival)
- Two cases of mortality (one at 20 weeks gestation)

JMM Case Rep. **4**: e005127; 2017

NON-TYPHOIDAL *Salmonella* spp.

- *Salmonella enteritidis*

27-week pregnancy; fever and diarrhea at labor
Caesarean section delivery (expired at four hours)
Several fetal cultures; maternal blood cultures

Obstet. Gynecol. **88**: 692-693; 1996

- *Salmonella* serotype Virchow (second trimester)

Scand. J. Infect. Dis. **36**: 773-774; 2004

- *Salmonella enteritidis*

Full-term; fever, slight diarrhea 2d before delivery
Neonatal sepsis 24h after birth; expired

J. Perinatol. **20**: 54-56; 2000

NON-TYPHOIDAL *Salmonella* spp.

- *Salmonella* serogroup C1

15-week pregnancy; miscarriage

~2 days after resolution of acute diarrheal illness

Obstet. Gynecol. **79**: 820-821; 1992

- *Salmonella* serotype Virchow (16-week pregnancy)

Clin. Microbiol. Infect. **9**: 866-868; 2003

- *Salmonella* serotype Mississippi

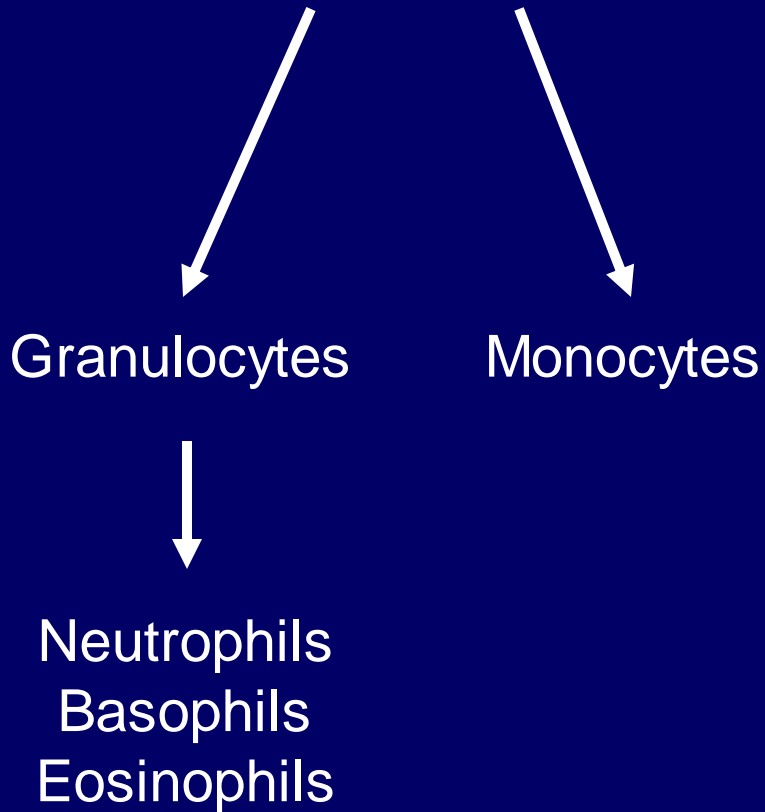
18-week pregnancy; miscarriage

~7 days after resolution of acute diarrheal illness

Arch. Gynecol. Obstet. **277**: 437-438; 2008

NATURAL IMMUNITY

Innate



Acquired

Cell-mediated

T-lymphocytes

Helper cells
Cytotoxic cells

```
graph TD; Acquired --> CellMediated[Cell-mediated]; Acquired --> HumoralMediated[Humoral-mediated]; CellMediated --> TL[T-lymphocytes]; TL --> HC[Helper cells]; TL --> CC[Cytotoxic cells];
```

Humoral-mediated

B-lymphocytes
(antibody)



PREGNANCY MECHANISM?

- Progesterone increase suppresses cell-mediated
Salmonella spp. *Listeria* spp. Hepatitis E
J. Food Prot. **62**: 818-829; 1999
- Bias from cell-mediated, inflammation phenotype
Affects control of intracellular pathogens
Immunol. Today. **14**: 353-356; 1993
- Intracellular location, replication rate also influence
Listeria monocytogenes **CYTOPLASM**
Mycobacterium tuberculosis **SLOW**
J. Immunol. **179**: 6088-6096; 2007

Salmonella spp. MECHANISM?

The Journal of Immunology

Pregnancy Impairs the Innate Immune Resistance to *Salmonella typhimurium* Leading to Rapid Fatal Infection¹

Branka Pejcić-Karapetrovic,^{2,3†} Komal Gurnani,^{3*} Marsha S. Russell,* B. Brett Finlay,[‡]
Subash Sad,*[†] and Lakshmi Krishnan^{4*†}

- Modified phagosome niche; rapid replication rate
4% of genome devoted to virulence mechanisms

Infect. Immun. **66**: 3372-3377; 1988

- *Salmonella* serotype Typhimurium utilizes placenta invasion to alter cytokine, cell regulatory networks

J. Immunol. **179**: 6088-6096; 2007