Mastitis Pathogens
Beyond the Usual Suspects

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Mastitis is usually described based on symptoms

- **Subclinical mastitis**
  - Milk appears normal but contains excessive numbers of inflammatory cells

- **Clinical mastitis**
  - Visual abnormalities of milk

- Symptoms are a result of the immune response of udder to **bacterial infection**

- 99% of mastitis occurs when bacterial exposure at teat end exceeds ability of immune defenses of cow
Bacteria that Cause Mastitis

- Categorized based on the reaction a simple dye makes with their cell wall
- **Gram positive**
  - Turn blue when dyed
  - Tend to be contagious bacteria
  - Often subclinical cases
- **Gram negative**
  - Turn red when dyed
  - Tend to be environmental bacteria
  - Greater proportion of clinicals
Many Bacteria Can Cause Mastitis

Prevalence of Pathogens Recovered from 108,000 cows in New York (50% No Growth)

Wilson et al., JDS 1997:2592
Relative importance of Environmental pathogens has increased in many modern herds

- Bacteria recovered from >77,000 milk samples in WI, 1994-2001
- Large decrease in the prevalence of the traditional subclinical contagious mastitis pathogens
  - S aureus & Strep ag
- Ecological niche has been occupied by opportunistic environmental pathogens
  - Changed nature of symptoms

Makovec & Ruegg, 2003. JDS
Causes of Subclinical Mastitis in WI Dairy Herds

Bacteria From Herds (40) with SCC >250,000; 5672 samples

- No Growth: 53%
- CNS, 15%
- Other, 15%
- Staph aureus, 4%
- Gram neg., 1%
- Strep ag, 1%
- Contam., 8%

Bacteria from CMT+ quarters; 5 herds; 426 samples

- No Growth: 33%
- CNS, 31%
- Other, 10%
- Staph aureus, 2%
- Strep spp., 8%
- Contam., 8%

Pol & Ruegg, JDS 2007
Apparao and Ruegg, Submitted 2008
Clinical Mastitis is Caused by Many Bacteria

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<tr>
<td>S aureus</td>
<td>?? 25%¹</td>
<td>5%</td>
<td>1%</td>
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<tr>
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<td>19%</td>
<td>29%</td>
<td>24%</td>
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¹Proportion caused by S. aureus is not stated
Depending on the Farm, teats are exposed to Different Pathogens
Dealing with “common but not usual” pathogens

- Coagulase negative staphylococci spp.
  - CNS
  - Environmental staphs…
- Klebsiella spp.
- Enterobacter spp.
- Pseudomonas spp.
- Serratia spp.
- Yeast
- Prototheca

198 Clinical Cases from 4 WI freestall Farms, 2009
Coagulase Negative Staphylococci

- Gram positive, non Staph aureus, staphylococci
  - 46 or more different species
- Staph that are do not test positive for one of the lab tests used to identify Staph aureus
  - “coagulase negative”
- Part of the normal skin flora of cows
- Isolated from 7-30% of quarters
- Higher incidence rate in first lactation
- Prevalence high after calving, decreases and then increases in late lactation
- Health of teat sphincter is a major barrier of entry to gland
CNS: Effect on SCC and Clinical Mastitis

- Relatively small SCC response to infection
  - SCC in infected quarters usually about 2-3X the SCC uninfected quarter
  - typical SCC of infected cow: 250,000-400,000
- 3-15% of clinical mastitis has been attributed to CNS in herds that have controlled major pathogens
Coagulase Negative Staph

**TREATMENT**
- Treatment of subclinical infections during lactation is NOT recommended
  - Spontaneous cure rates up to 80%
- Clinical cases should respond to typical commercial intramammary tubes
  - Short duration therapy

**CONTROL**
- Post-milking teat dip
  - Infections increase when post dipping not used
- Good pre-milking hygiene
- Healthy teat ends
- Wear gloves
- Milking Routine
- Dry cow therapy is effective
Klebsiella spp.

- Gram negative coliform
- An environmental pathogen
  - Lives in organic bedding sources
    - Especially wood products
    - Can be a big problem for compost barns
  - Shed in manure of healthy cows
    - Can contaminate sand
- Often a bigger problem in summer
- Symptoms cannot be distinguished visually from other bugs
Klebsiella spp. – Effect on SCC & Clinical Cases

- Klebsiella oxytoca & pneumoniae
- Clinical cases can range from mild to very severe
- Some strains can become adapted to living in the cow and cause persistent subclinical mastitis
- Period of increased SCC is longer than in mastitis caused by E. coli
Klebsiella Mastitis

**Treatment**

- No effective treatments
- No evidence to suggest that Spectramast is effective
- Vaccination with J5 should reduce severity of symptoms

**Control**

- Reduce exposure by increasing hygiene
- Remove bedding that is contaminated
  - Black sand layer
  - Wet compost
- Excellent premilking teat preparation
Enterbacter spp.

- Another coliform bacteria
  - Some labs may not differentiate these from other coliforms
    - May confuse with Klebsiella
- Live in the same environments that harbor E. coli
  - Organic bedding material
  - Moisture
Enterobacter: SCC & Treatments

- Behave very similar to typical E. coli mastitis
- Can cause mild to severe clinical mastitis
  - Of 8 cases in WI data, 6 were severity score 2 & 2 were severity score 1
- No approved treatments
- No data about effectiveness of treatments
  - 8 cows in dataset all received Spectramast LC
- No expectation that available drugs would be effective
**Pseudomonas aeruginosa**

- Gram negative environmental pathogen
- Generally associated with contaminated water supply
  - Herd outbreaks
- Can be found in bulk tank cultures because of contamination during sampling
- Can cause acute to subclinical mastitis
  - About 1% of cases
- Treatment is not usually effective
Serratia spp.

- Serratia marcescens; S. liquefaciens most common
  - Recovered from 5% of clinical cases in WT data
- Appear to have become more common
- Usually are considered environmental pathogens
  - Found in many types of organic bedding
  - Become subclinical & can spread in a contagious manner
- Occasionally associated with outbreaks that are spread via teat dip
  - Some dips appear to be good growth media for this organism if the dip becomes contaminated
    - Chlorhexidine gluconate has been implicated
Serratia: SCC & Treatments

- Usually cause mild clinicals and **chronic** subclinical cases
  - Of 8 cases in WI data, 6 were severity score 1 & 2 were severity score 2
  - Often have recurrent cases
    - 6 of 8 had previous mild clinicals
- No approved treatments
- Occasional spontaneous cures
- Control
  - Identify and segregate or cull chronically infected cows
  - Excellent bedding management
  - Don’t use chlorhexidine dip in herds with a serratia problem

SCC of 8 WI Cows with Clinical Mastitis Caused by Serratia

Test Date Relative to Clinical Case

SCC (x 1000)
Yeast Mastitis

- Candida albicans and Cryptococcus are most common
- Will occur as Gram positive organism on blood agar
- Occurs sporadically in some herds or as an outbreak
- Most common risk factor is recent administration of an intramammary antibiotic
  - Overtreatment, multidose homemade products or poor hygiene during administration
Yeast Mastitis

**Treatment**
- No effective treatments
- Stop all antibiotic treatments
  - May increase the symptoms or prolong subclinical phase
- Many cases spontaneously cure after a couple of months
  - Or after the dry period

**Control**
- Teach all farm personnel to administer products properly
- Use only commercially prepared, FDA approved intramammary treatments
Prototheca Mastitis

- Algae that are associated with water
  - Prototheca zopfii & wickerhamii
- Will grow on blood agar
  - Not all labs will identify
- Occur sporadically in some herds or as an outbreak
  - Clinical & subclinical
- Often live in decaying organic matter, soil, ponds, feces of cows or small mammals
  - Usually, pointless to try to culture environment to find source
Prototheca Mastitis

**Treatment**

- No effective treatments
- Pointless to treat using antibiotics
- Most cases will NOT self-cure
- Usually will want to cull infected cows

**Control**

- Identify and remove potential areas that algae can grow
- Control rodents & other small mammals
- Segregate and eventually cull infected cows
In modern dairy herds, about 20% of mastitis is caused by “other bacteria”

The symptoms may be identical to symptoms of mastitis caused by traditional bugs (Staph, Strep, E.coli)

Culturing in a good laboratory is the only way to identify the pathogens

Most of the “unusual” bugs will not respond to treatment and must be prevented
Questions?