• Created with $60 million appropriation from Florida state legislature, focusing on human, animal, and plant pathogens

• Over 200 faculty members, from 10 UF colleges (including medicine, public health, veterinary medicine, and agriculture)

• Strong global emphasis, driven by Florida’s sub-tropical location, and the critical role of trade (including agricultural trade) and tourism in the Florida economy
EPI Collaborative Research Sites
What is an “Emerging Pathogen”?

A disease-causing microorganism that is newly recognized and/or increasing in frequency in human, animal, or plant populations

• Examples:
  – H1N1 swine flu/pandemic flu
  – West Nile, Dengue, Chikungunya
  – Multi-drug resistant TB
  – AIDS
  – MRSA (methicillin-resistant *Staphylococcus aureus*)
  – *E. coli* O157:H7
  – Citrus greening
Why do Pathogens Emerge?

- Appearance of new/genetically different strains
- Changes in opportunities for pathogen growth and spread (often anthropogenic)
- Change in host susceptibility
EPI: Focus Areas

- Vectorborne diseases
  - Malaria, Dengue, Chikungunya
  - Citrus Greening
- Tuberculosis/mycobacterial disease
- Influenza/cross-species viral transmission
- MRSA/antimicrobial resistance
- Enteric pathogens/cholera/foodborne disease
Staphyloccus aureus: “Waves of Resistance”
CA-MRSA

Prototype: **USA300**
- **SSCmec** type IV
- **MLST** ST8
- **spa** type t008
- **PVL** positive
- Frequently susceptible to many non-β lactam antibiotics

- Outpatients who were admitted
  - increase in MRSA from 26.8% to 52.4% of all Staph isolates
- Inpatient data
  - Increase in MRSA from 46.7% to 58.5%
    - Decrease in HA-MRSA from 43.4% to 38.7%
    - Increase in CA-MRSA from 3.3% to 19.8%

Diagnosis of *S. aureus*-related hospitalizations, U.S., 1999-2005
MRSA: SSTI

• Purulent skin/soft tissue infections
  – Most common presentation of CA-MRSA
  – “spider bite” appearance (central black eschar): positive predictive value of 94%, negative predictive value of 45%
  – Also: folliculitis, paronychia, furuncle, felon, cellulitis with drainage, lymphadenitis
MRSA: Transmission

- Reservoir: nose, throat, “hairy areas”
  - 20% - persistent carrier
  - 60% - intermittent carrier
  - 20% - never carry

- Transmission via hands, fomites
  - Dry mops up to 4 weeks
  - Table tops for more than a week
  - Mattresses for months

- Infection strongly linked with colonization at the time of admission (>80% of patients with MRSA BSI)
Groups at Risk for CA-MRSA

- Neonates
- Children beyond the neonatal period
- Athletes
- Household contacts of MRSA patients
- Emergency Department patients
- Urban underserved communities
- Indigenous populations
- Detainees in jail
- Veterinarians, livestock handlers, and pet owners
- Cystic fibrosis patients
- Military personnel
- Men who have sex with men
- HIV patients
- People at beaches
MRSA in dog, cat, and horse patients of 3 secondary and tertiary care facilities in North-Central Florida

<table>
<thead>
<tr>
<th></th>
<th>No. Sampled per Species (Samples Processed per Species)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dog</td>
</tr>
<tr>
<td>Sampling period 1</td>
<td>107 (126)</td>
</tr>
<tr>
<td>Sampling period 2</td>
<td>429 (459)</td>
</tr>
<tr>
<td>Total</td>
<td>536 (585)</td>
</tr>
<tr>
<td>Total MRSA</td>
<td>2</td>
</tr>
<tr>
<td>Prevalence</td>
<td>0.37%</td>
</tr>
</tbody>
</table>

* 4/6 USA300
Isolated bacterial DNA is sequenced to obtain a full genome for every MRSA culture.
Bayesian phylogeny
Distribution of MRSA spa types across six different hospitals in Jacksonville (J) and one in Gainesville (G), collected during 2010 (n = 97).
Techniques Allow Us to -

- Look for discrete sub-epidemics
- Uncover the existence of potential MRSA reservoirs in the community
- Calculate the exchange rate (colonization rate) of MRSA between hospitals and community
- Develop mathematical models of disease transmission

See what we can do to slow down or stop spread of MRSA in North Florida
THE KILLER GERM

It's turning up everywhere: in your water, your food, the pool. How to protect yourself from E.COLI
E. coli “pathotypes” Associated with Human Disease

- Enterotoxigenic *E. coli* (ETEC)
- Enteroinvasive *E. coli* (EIEC)
- Enteropathogenic *E. coli* (EPEC)
- Enteroaggregative *E. coli* (EAgEC)
- Enterohemorrhagic *E. coli* (EHEC/STEC)
  - Produces Shiga toxin
  - In U.S.: *E. coli* O157:H7 most common form
Reported Outbreaks/Cases of \textit{E. coli} O157:H7, 1982-96
E. coli O157:H7: Clinical Features

- 30-95% of patients have bloody diarrhea
- 2-7% develop hemolytic-uremic syndrome
  - breakdown of red blood cells
  - kidney failure
- Mortality rates of <1%-35%, depending on affected population; rates highest in elderly, children under 5
Escherichia coli 0157:H7
### E. coli O157:H7 Outbreaks, 1982-1996

Vehicles/Routes of Transmission

<table>
<thead>
<tr>
<th>Source</th>
<th># Outbreaks (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 125)</td>
</tr>
<tr>
<td>ground beef</td>
<td>40 (32%)</td>
</tr>
<tr>
<td>water (swimming/drinking)</td>
<td>13 (10%)</td>
</tr>
<tr>
<td>vegetables/salads/salad bars</td>
<td>11 (9%)</td>
</tr>
<tr>
<td>apple cider</td>
<td>4 (3%)</td>
</tr>
<tr>
<td>roast beef</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>venison</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>person-to-person</td>
<td>21 (17%)</td>
</tr>
<tr>
<td>misc/unknown</td>
<td>30 (24%)</td>
</tr>
</tbody>
</table>
**E. coli O157:H7: Epidemiology**

- Present as asymptomatic colonizer in intestinal tract of cattle
  - isolated from up to 38% of cattle at time of slaughter
- May contaminate surface of meat during slaughter/processing
- Low infectious dose
  - can be transmitted person-to-person
  - <100 bacteria can cause illness
**E. coli O157:H7**

**Epidemiology**

- Present in a food (ground beef) which is not always fully cooked by the consumer
- May contaminate other foods that are not subsequently cooked
Production of Ground Beef

- Commercial grinding plant: 2-30 ton lots
- Re-grinding, packaging by supermarket
- Consumer

Sources:
- Source A
- Source B
- Source C
- Source D

International sources

Supermarket meat scraps
Spinach and *E. coli* O157:H7

**Number of cases occurring between Aug. 19 and October 6, 2006, by state**

- 1-4 cases
- 5-9 cases
- 10-14 cases
- 15 or more cases
Spinach and EHEC
STEC: Recent Outbreaks

- Dec 2012, O157:H7: Organic spinach and spring mix blend
  - 33 cases, 13 hospitalizations, 0 deaths
- May, 2013, )121: Farm Rich brand frozen food products
  - 35 cases, 9 hospitalizations, 0 deaths
- Dec 2013, O157:H7: Ready to eat salads, Glass Onion Catering/Trader Joes
  - 33 cases, 7 hospitalizations, 0 deaths
- May, 2014, O157:H7, ground beef
  - 11 cases, 6 hospitalizations; 1.8 million lbs ground beef recalled
“The phylogenetic network applied to 48 parsimonious informative (PI) sites using the Neighbor-net algorithm for 528 *E. coli* O157 strains”

Manning S. D. et.al. PNAS 2008;105:4868-4873
“German” *E. coli*

- ECDC: As of July 19, 2011, over 3900 cases, including 852 HUS cases and >42 deaths
- Genetically: shiga toxin gene from EHEC in EAgEC genetic background
- Sprouts likely source; fenugreek seeds from a single Egyptian exporter
The Long Pathway of Fenugreek Seeds

November 2009

Egypt → German importer 15,000 kg

- Containerized in Damietta, Egypt
- Boat to Antwerp, Belgium
- Barge to Rotterdam, Netherlands
- Trucked to Germany

• Additional shipments from shipper totaling 22,000 kg between 2008-2011
• In 2010, EU bought 77,000 kg (77 metric tons) of fenugreek seeds from Egypt

German distributor 1 10,500 kg

- Distributor A
  - Other companies
  - 54 companies in Germany
- Distributor B
  - 16 companies in 11 other EU countries

9 additional German companies 3,350 kg

- Spanish company 375 kg
- Austrian distributor 250 kg
- British company 400 kg

French distributor (1200 envelopes)

200+ garden centers (5-125 seed packets per firm)

AddiMonal shipments from shipper totaling 22,000 kg between 2008-2011

In 2010, EU bought 77,000 kg (77 metric tons) of fenugreek seeds from Egypt

May-July 2011

First wave of illness (Germany)

Second wave of illness (France)
