Understanding Drug-Induced Adverse Events and Nutrient Interactions: Antibiotics and Antibacterials

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Antibiotics and Anti-Infectives

- Antibiotics
  - Penicillins
  - Cephalosporins
  - Other beta-lactams (Carbapenems)
  - Aminoglycosides
  - Macrolides
  - Quinolones
  - Tetracyclines
- Anti-Infectives
  - Sulfonamides
  - Flagyl

Penicillins

- Amoxicillin (Amoxil)
- Ampicillin (Amcil, Principen)
- Carbenicillin (Geocillin)
- Cloxacillin (Tegopen)
- Dicloxacillin (Dynapen)
- Methicillin (Stapcillin)
- Nafcillin (Unipen)
- Oxacillin (Prostaphin)
- Penicillin G (Pentids)
- Penicillin V (Pen-Vee-K)
- Piperacillin (Pipacil)
- Ticarcillin (Ticar)

Penicillin Combinations

- Amoxicillin/Clavulanate (Augmentin)
- Piperacillin/Tazobactam (Zosyn)
- Ampicillin/Sulbactum (Unasyn)
- Ticarcillin/Clavulanate (Timentin)

Penicillins- Pharmacist's Point

- Even though the first antibiotic discovered it's main use today is dental pre-medication.
- Prophylactic use in dental procedures (mitral valve prolapse infection risk)
- Amoxicillin is the drug of choice for otitis media.
- Allergic reactions occur in up to 10% of patients with 0.001% dying from anaphylaxis[1].
  - Lin RY, A perspective on penicillin allergy. *Arch Intern Med.* 1992;152(5):930-937.

Cephalosporins

1st Generation
- Cefazolin (Ancef)
- Cephadrine (Velocef, Ancef)
- Cephalexin (Keflex)
- Cefadroxil (Duricef)

2nd Generation
- Cefprozil (Cefzil)
- Cefaclor (Ceclor)
- Cefotstan (Cepfotan)
- Cefuroxime (Ceftin)
- Cefoxitin (Mefoxin)

3rd Generation
- Cefotaxime (Claforan)
- Ceftriaxone (Rocefin)
- Cepodoxime proxetil (Vantin)
- Cefdinir (Omnicef)
- Cefditoren (Spectracef)
- Cefizoxime (Cefizox)
- Cefixime (Suprax)
- Ceftbuten (Cedax)
- Cefoperazone (Cefobid)
- Ceftazidine (Fortaz)

4th Generation
- Cefepine (Maxipime)

5th Generation
- Ceftobiprole (Zeftera)

Cephalosporins- Pharmacist's Point

- Major use is soft skin infections
- And where patient is allergic to penicillins
- 1 to 3% develop allergic reaction
  - Rash
  - Fever
  - Eosinophilia
  - Urticaria
  - Anaphylaxis (rare)

Carbapenems

- Ertapenem (Invanz)
- Imipenem/Cilastatin (Primaxin)
- Doripenem (Doribax)
- Meropenem (Merrem)

Carbapenems – Pharmacist's Point

- Main use is in long term care in facilities and hospitals where resistance is seen most.

Aminoglycosides

- Amikacin (Amikin)
- Gentamycin (Garamycin)
- Kanamycin (Kantrex)
- Neomycin (Mycifradin)
- Tobramycin (Nebcin, Tobrex)
- Paromomycin (Humatin)

Aminoglycosides- Pharmacist's Point

- Narrow margin of safety
- Very ototoxic

Macrolides

- Azithromycin (Zithromax)
- Clarithromycin (Biaxin)
- Dirithomycin (Dynabac)
- Erythromycin (Erythrocin)
- Troleandomycin (TAO)
- Telithromycin (Ketek)
- Spectinomycin (Trobicin)

Macrolides- Pharmacist's Point

- First line of defense in Upper Respiratory Tract Infections (sinus, bronchitis)
- More drug interactions than any other antibiotic due to its effect on P450 enzymes
- #1 Side effect upset stomach and diarrhea

Quinolines

- Ciprofloxacin (Cipro)
- Gatifloxacin (Zymar)
- Gemifloxacin (Factive)
- Levofloxacin (Levaquin)
- Moxifloxacin (Avelox, Vigamox)
- Norfloxacin (Chibroxin)
- Oflocacin (Floxin, Ocuflox)

Quinolones- Pharmacist's Point

- Most over-prescribed antibiotic
- #1 used in feed industry to prevent infections increasing risk of resistance in humans
- Can cause serious tendon and muscle tears with exertion
- No strenuous exercise when taking

Tetracyclines

- Demeclocycine (Declomycin)
- Doxycycline (Vibramycin, Doryx, Oracea, Periostat)
- Minocycline (Minocin, Solodyn)
- Oxytetracycline (Terramycin)

Tetracyclines- Pharmacist's Point

- Main use is Acne
- Greatest cause of vaginal yeast infections
- Can cause graying of teeth in young children because it binds up calcium

Sulfonamides

- Sulfisoxazole (Gantrisin)
- Sulfacetamide (Bleph-10)
- Silver Sulfadiazine (Silvadene)
- Sulfamethoxazle/Trimethoprin (Septra, Bactrim, SMZ-TMP)

Sulfonamides- Pharmacist's Point

- Mostly used in children's ear infections and female urinary tract infections
- Has the most allergic reactions compared to other antibiotics

Metronidazole

Metronidazole (Flagyl, Metrogel, Vandazole)

Used for:

- Anaerobic infections
- Gynecological infections
- Bacterial septicemia
- Amoebiasis
- Trichomoniasis
- Rosacea (topically)

Unlabled uses:

- Crohn's disease
- C. diff associated diarrhea
- Bacterial vaginosis (vaginally)

Metronidazole- Pharmacists Point

- Has also been used in alcoholics
- Alcohol and Metronidazole turn to formaldehyde in the body
- No alcohol within 72 hours after use

General Characteristics of all Antibiotics

- Characteristics that all antibiotics share:

1. Can elicit allergic responses
   - Mild annoying rashes
   - life threatening reactions (anaphylaxis or Steven-Johnson Syndrome)
2. Target normal body flora as well as pathogens
   - *can cause overgrowth of Candida* or *Clostridium difficile*
   - Overgrowth of C. difficile
     - symptoms ranging from mild diarrhea to severe life threatening complications such as pseudomembranous colitis[1].

1. Poutanen SM, Simor AE, *Clostridium difficile associated diarrhea in adults. CMAJ. 2004;171(1):51-58.*

Definitions

- Bacteriostatic
  - Only slows the growth or reproduction
    - limits the growth of bacteria by interfering with bacterial protein production, DNA replication, or other aspects of bacterial cellular metabolism
    - inhibits growth and reproduction of bacteria without killing them; killing is done by bactericidal agents
    - must work with the immune system to remove the microorganisms from the body
- Bacteriocidal
  - Kills the bacteria
    - Bactericides (e.g. Penicillin, Cephalosporins, fluoroquinolones, nitrofurans, vancomycin, monobactams, co-trimoxazole, and metronidazole)
    - Aminoglycosides- can act in both a bactericidal or bacteriostatic manner.

Antibiotic Resistance

Bacteria develop resistance to antibiotics in a variety of ways including[1]:

1. May decrease the intracellular concentrations of the antibiotic
2. Deactivate the antibiotic
   - E.g. the enzyme lactamase deactivates beta-lactams
3. Change the binding sites for the antibiotic
4. Develop adaptation that bypass the need for the binding site targeted by the antibiotic

1. Kaye KS, Fraimow HS, Abrutyn E. Pathogens resistant to antimicrobial agents: epidemiology, molecular mechanisms, and clinical management. *Infect Dis Clinics North Am.* 2000;14(2):293-319.

The continuing crisis in antibiotic resistance.

- The emergence of antibiotic resistance in bacterial pathogens is an inevitable consequence of antibiotic use.
- Despite repeated warnings, negligent antibiotic use and poor infection-control practice have led to the continuing development of extensive resistance problems world wide.
- Examples are MRSA and toxin hyperproducing Clostridium difficile

- PMID: 21129629
- Department of Infection, King's College, Guy's & St Thomas' Hospital, London, UK
- Int J Antimicrob Agents. 2010 Nov;36 Suppl 3:S3-7

Antibiotics in Livestock

"The Food and Drug Administration reported recently that 80 percent of antibiotics in the United States go to livestock, not humans.

And 90 percent of the livestock antibiotics are administered in their food or water, typically to healthy animals to keep them from getting sick when they are confined in squalid and crowded conditions."

From Nicholas Kristof's New York Times column June 11th
http://www.nytimes.com/2010/03/07/opinion/07kristof.html

Antibiotic-Associated Adverse Events Often Require Emergency Care

- Drug-related adverse events are an under-appreciated consequence of antibiotic use; antibiotics are prescribed to an estimated 16% of the population
- 6614 Cases; 142,505 Emergency Department (ED) visits related to antibiotics annually, particularly due to allergic reactions
- 78.7% of the visits were allergic reactions (6.1% led to hospitalization)
- Ages 15-44 accounted for 41.2% of the ED visits
- Antibiotic-associated adverse events was 10.5 ED visits per 10,000 outpatient prescription visits.
  - This rate was 3 x higher vs. adverse events in anticoagulants or oral hypoglycemic agents

Antibiotic-Associated Adverse Events Often Require Emergency Care (cont.)

- Sulfonamides and fluoroquinolones - highest rates of neurologic or psychiatric effects
- Sulfonamides significantly higher rate of severe allergic reactions vs. all other classes
- Penicillins and Cephalosporins were implicated in ½ of the ED visits (36.9% vs 12.2%, respectively).

- http://www.medscape.org/viewarticle/582210
  - Clin Infect Dis. 2008;47:735-743, 744-746

The microbiota and infectious diarrhea.

- Understanding the importance of the fecal microbiota has been key in understanding infectious diarrheas.
- Bile, gastric acid, immune response, and healthy gut flora protects from infectious diarrheas
- Antibiotic associated diarrhea (AAD) is an excellent example of disrupting healthy flora
- Clostridium difficile diarrhea is a difficult clinical problem because one recurrence makes further recurrences more likely.
- There is no single effective treatment but therapies include pulsed and tapered antibiotics, and probiotics as an adjunct to antibiotics

- PMID: 20889002
- University of Washington School of Medicine, Seattle, WA
- Gastroenterol Clin Biol. 2010 Sep;34 Suppl 1:S29-36.

Clostridium difficile

- Most common symptoms:
  - Watery diarrhea
  - 3 or more times a day for 2 or more days
  - Mild abdominal cramping and tenderness

- Severe symptoms
  - watery diarrhea 10-15 times per day
  - severe abdominal cramping and pain
  - fever
  - blood or pus in stool
  - nausea
  - dehydration
  - loss of appetite
  - weight loss

Clostridium-difficile-associated infections

- C. difficile
  - responsible for virtually all cases of pseudomembranous colitis
  - 15 to 25% of cases of antibiotic-associated diarrhea

- PMID: 20188046

- Université Pierre et Marie Curie, Paris VI, Faculté de médecine Saint-Antoine, 75571 Paris Cedex 12, France

- Med Sci (Paris). 2010 Feb;26(2):153-8.

Clostridium difficile and the disease it causes.

- A spore-forming, toxin-producing, anaerobic bacterium
- Antimicrobials disrupt the intestinal microflora
- production of toxin A and B it precipitates C. difficile infection (CDI)
- slow recolonization of the normal flora likely responsible for single or multiple recurrences of CDI (25-50%)
- Standard therapy still consist of either oral metronidazole or vancomycin
- Excessive use of fluoroquinolones is thought to play an important role in facilitating this epidemic
- Global spread of C. difficile

- PMID: 20597000
- Department of Infectious Diseases, Orebro University Hospital and Orebro University, Orebro, Sweden
- Methods Mol Biol. 2010;646:9-35.

The growing incidence and severity of Clostridium difficile infection in inpatient and outpatient settings.

- C. Difficile
  - incidence and severity on the rise over the last 10-20 years
  - increasingly found outside the healthcare setting and in populations thought to be at low risk
- Increase in the morbidity, mortality and economic burden
- Emergence of a hypervirulent C. difficile strain

- PMID: 20678014
- Mayo Clinic College of Medicine, 200 First Street SW, Rochester, MN 55905, USA.
- Expert Rev Gastroenterol Hepatol. 2010 Aug;4(4):409-16.

Clostridium difficile-associated diarrhoea.

- There has been concern about the emergence of a hypervirulent fluoroquinolone-resistant strain of C. difficile in North America and Europe.

- PMID: 17640189

- Microbiology and Immunology, The University of Western Australia, Perth, Western Australia

- Intern Med J. 2007 Aug;37(8):561-8.

[Epidemiology of Clostridium difficile infection].

- Pseudomembranous colitis (PMC), antibiotic-associated diarrhoea (AAD), and colitis (AAC) caused by Clostridium difficile are recognized as complications of antibiotic treatment (cephalosporins, penicillins, clindamycin and others).

- PMID: 12150067
- Przegl Epidemiol. 2002;56(1):49-56

Clostridium difficile--Associated diarrhea: A review.

- Causes 300,000 to 3,000,000 cases of diarrhea and colitis in the U.S. every year
- Antibiotics most associated with the infection are clindamycin, ampicillin, amoxicillin, and cephalosporins.
- Oral metronidazole or oral vancomycin hydrochloride for 10 to 14 days are equally effective at resolving clinical symptoms
- Approximately 15% of patients experience relapse after initial therapy

- PMID: 11252111

- Division of Infectious Diseases, Gray-Jackson 504, Massachusetts General Hospital, 55 Fruit St, Boston, MA 02114, USA

- Arch Intern Med. 2001 Feb 26;161(4):525-33.

Established and potential risk factors for Clostridum difficile infection.

- Severe cases of toxic mega colon may be associated with mortality rates of 24-38%
- Surgical patients comprise 55-75% of all patients with C. Difficile Associated Diarrhea
- Other drugs such as immunosuppressants and proton pump inhibitors are also important risk factors

- PMID: 19736396
- Indian J Med Microbiol. 2009 Oct-Dec;27(4):289-300.

Early antibiotic treatment and later asthma.

- Population-based study of 2,512 children age 5-14
- Wheezing was associated with increasing number of antibiotic courses; the risk increased with earlier administration.
- Early antibiotic treatment could itself be related to later asthma.

- PMID: 11432798
- Eur J Med Res. 2001 Jun 28;6(6):263-71.

Neonatal antibiotic treatment is a risk factor for early wheezing.

- Treatment with antibiotics in the neonatal period was an independent risk factor for wheezing that was treated with inhaled corticosteroids at 12 months of age.

- Alteration in the intestinal flora can increase the risk of subsequent wheezing.

- PMID: 18381533
- Pediatrics. 2008 Apr;121(4):697-702.

Increased Risk of Childhood Asthma From Antibiotic Use in Early Life

- 1995 birth cohort of 13,116 children
- Asthma was significantly more likely to develop in children who had received antibiotics in the first year of life at age 7 years
- Antibiotic use in early life was associated with the development of childhood asthma, a risk that may be reduced by avoiding the use of BS cephalosporins.
  - http://chestjournal.chestpubs.org/content/131/6/1753.abstract

Antibiotic exposure by 6 months and asthma and allergy at 6 years: Findings in a cohort of 1,401 US children.

- Antibiotic exposure was associated with increased risk of asthma
- The adverse effect of antibiotics was particularly strong in children with no family history of asthma
- The results show that early antibiotic use was associated with asthma and allergy at 6 years of age.

- PMID: 21190986
- Am J Epidemiol. 2011 Feb 1;173(3):310-8. Epub 2010 Dec 29.

Antibiotic use in children is associated with increased risk of asthma.

- Increased courses of antibiotics increased asthma risk
- Highest risk >4 courses
- All antibiotics were associated with increased risk of asthma (exception was sulfonamides)
- CONCLUSIONS: use of antibiotics in the first year of life is associated with a small risk of developing asthma
  - risk increases with the number of courses of antibiotics prescribed

- PMID: 19255032
- Pediatrics. 2009 Mar;123(3):1003-10.

The prenatal use of antibiotics and the development of allergic disease in one year old infants. A preliminary study.

- Prenatal use of antibiotics- Nonsmoking women, aged 18-35 years
- 102 newborns were followed-up every three months over one year
- Relative risk for persistent wheezing was significantly associated with the duration of antibiotic therapy
- It was significant if the antibiotic treatment took place in the second and the third trimester
  - Hay fever and eczema risk was also seen.
- CONCLUSIONS: The study suggests that maternal use of antibiotics during pregnancy may prove to be a risk factor for persistent wheezing and development of allergy in early infancy.

- PMID: 16881601
- Int J Occup Med Environ Health. 2006;19(1):70-6.

Caesarean section delivery and the risk of allergic disorders in childhood.

- intestinal flora in young children, if unfavourable, may increase the susceptibility to allergic disorders
- Beneficial intestinal microbes originate from the maternal vaginal tract and are more likely to be transferred during vaginal births
- Risk of allergic rhinoconjunctivitis (AR) was significantly higher in C-section births
- Conclusion: Caesarean sections may be associated with an increased risk of developing AR in childhood.
  - PMID: 16297144
  - Clin Exp Allergy. 2005 Nov;35(11):1466-72.

Birth by cesarean section, allergic rhinitis, and allergic sensitization among children with a parental history of atopy.

- Cesarean delivery can alter neonatal immune responses
- Children born by cesarean section had 2-fold higher odds of atopy
- CONCLUSIONS: Our findings suggest that cesarean delivery is associated with allergic rhinitis and atopy among children with a parental history of asthma or allergies. This could be explained by lack of contact with the maternal vaginal/fecal flora
  - PMID: 18571710
  - J Allergy Clin Immunol. 2008 Aug;122(2):274-9.

Probiotics for the treatment or prevention of atopic dermatitis: a review of the evidence from randomized controlled trials.

- Mothers were administered Lactobacillus rhamnosus GG followed by treatment of the infants with the same probiotics for the first 6 months of life.

- Probiotics, especially L. rhamnosus GG, seem to be effective for the prevention of AD. They were also found to reduce the severity of AD in approximately half of the RCTs evaluated.

- PMID: 18284263
- Am J Clin Dermatol. 2008;9(2):93-103.

Probiotic supplement reduces atopic dermatitis in preschool children: a randomized, double-blind, placebo-controlled, clinical trial

- Randomized, double-blind, placebo-controlled
  - 90 children aged 1-3 years with moderate-to-severe AD
  - treated with a mixture of probiotic with FOS (5 billion colony-forming units twice daily for 8 weeks versus placebo)
  - Primary outcome measure was change in Scoring of Atopic Dermatitis (SCORAD) value
- RESULTS: Children receiving probiotic showed a greater decrease in SCORAD at week 8
- CONCLUSION: The administration of a probiotic mixture was associated with significant clinical improvement in children with AD

- PMID: 20642296
- Am J Clin Dermatol. 2010;11(5):351-61

Small Intestine Bacterial Overgrowth (SIBO)

- **Creating an unstable environment**
  - Antibiotic overuse
  - Decreased HCL
  - Decreased Pancreatic Enzymes
  - Radiation damage
  - Lymphoma
  - Crohn's disease
  - Parasitic infections
  - Decrease in sigA
  - Systemic lupus erythematous
  - Diabetes

Small Intestine Bacterial Overgrowth (SIBO)

- SIBO
  - an overgrowth of more than 10 to the 5th CFU/ml of bacteria in the proximal small bowel

PMID 8438647

Small Intestine Bacterial Overgrowth (SIBO)

OVERGROWN PATHOLOGIC FLORA CAN

- Inactivate pancreatic and brush border digestive enzymes
- Destroy dietary flavanoids
- Hydrogenate PUFA
- De-conjugate bile salts
- Consume Vitamin B12
- Produce Vitamin B12 antagonists
- Produce nitrosamines

Small Intestine Bacterial Overgrowth (SIBO)

- **CAN CAUSE**
  - Mal-digestion
  - Mal-absorption
  - Altered permeability
  - Anemia
  - Weigh loss
  - Osteomalacia

- **SYMPTOMS**
  - Gas and bloating
  - Abdominal pain
  - Diarrhea
  - Constipation
  - Fatigue
  - Weight loss

Bacterial populations contaminating the upper gut in patients with small intestinal bacterial overgrowth syndrome.

- CONCLUSIONS: Contaminating flora isolated in SIBOS include commonly identified oropharyngeal and colonic flora
  - PMID: 10235214
  - Am J Gastroenterol. 1999 May;94(5):1327-31.
- People with AAD* have higher Candida counts
  - *Clin Diagn Lab Immunol*.2003 Jan;10(1):167-8.
  - *AAD Antibiotic Associated Diarrhea

Small intestinal bacterial overgrowth syndrome.

- Defense mechanisms for preventing bacterial overgrowth
  - gastric acid secretion, intestinal motility, pancreatic and biliary secretion

- Etiology of SIBO is usually complex
  - **disorders of protective antibacterial mechanisms** (e.g. achlorhydria, pancreatic exocrine insufficiency, immunodeficiency syndromes)
  - **anatomical abnormalities** (e.g. small intestinal obstruction, diverticula)
  - **motility disorders** (e.g. scleroderma, autonomic neuropathy in diabetes mellitus)
  - In some patients more than one factor may be involved.

- The gold standard for diagnosing SIBO- jejunal aspirates
- Non-invasive method- hydrogen and methane breath tests (lactulose, glucose)

- PMID: 20572300
- World J Gastroenterol. 2010 Jun 28;16(24):2978-90.

SIBO

JAMA®
The Journal of the American Medical Association

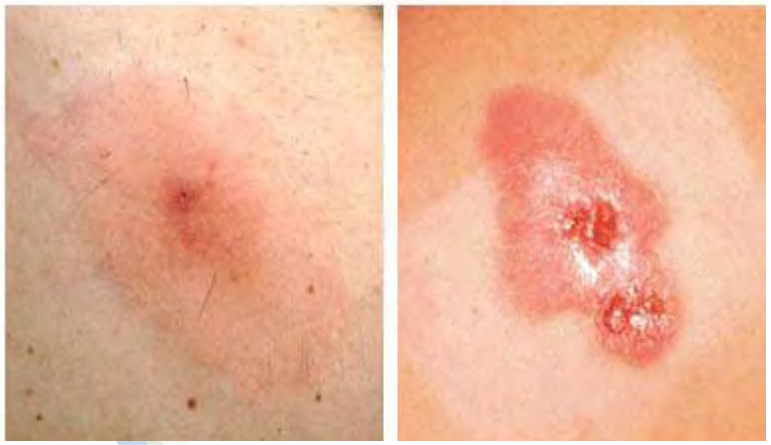
- Small Intestinal Bacterial Overgrowth (SIBO) A Framework for Understanding Irritable Bowel Syndrome
- **Irritable bowel syndrome (IBS) affects 11% to 14% of the population**
  - 92% IBS patients share the symptom of bloating
- SIBO may explain bloating in IBS
  - abnormal lactulose breath test in **84%** of IBS patients
  - **75% improvement of IBS symptoms after eradication of SIBO**
- Altered gastrointestinal motility and sensation
- Frequent observations in IBS
  - postprandial bloating and distension
  - altered motility
  - visceral hypersensitivity
  - abnormal brain-gut interaction
  - autonomic dysfunction
  - immune activation

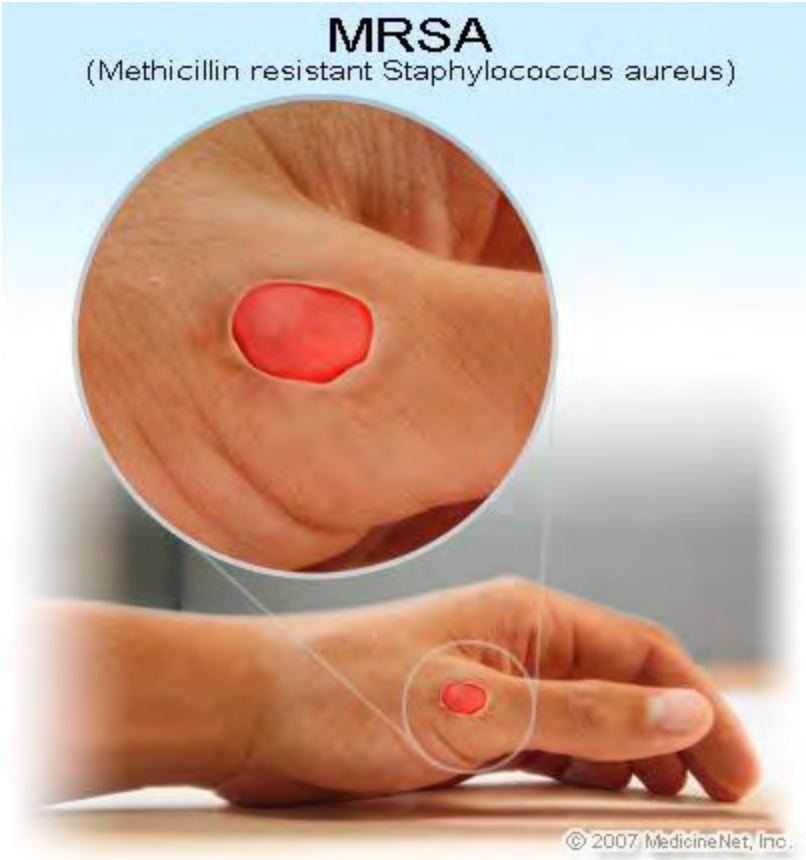
JAMA. 2004;292:852-858. http://jama.ama-assn.org/cgi/content/full/292/7/852

Methicillin-resistant Staphylococcus aureus (MRSA)

- Healthy people carry staph without being infected by it
  - 25%-30% have staph bacteria in the nose
- One of the most common causes of skin infections in the U.S. Usually minor (no special treatment)
  - But staph can also cause serious problems (e.g. infected wounds or pneumonia)
- MRSA was first discovered in 1961. It's now resistant to methicillin, amoxicillin, penicillin, oxacillin, and many other antibiotics.

Methicillin-resistant Staphylococcus aureus (MRSA)





MRSA infections start out as small red bumps that can quickly turn into deep, painful abscesses.

Methicillin-resistant Staphylococcus aureus (MRSA)

Because hospital and community strains of MRSA generally occur in different settings, the risk factors for the two strains differ.

Methicillin-resistant Staphylococcus aureus (MRSA)

Risk factors for Health care-associated MRSA (HA-MRSA)

- Being hospitalized
- Having an invasive medical device
- Residing in a long term care facility

Risk factors for Community-associated MRSA (CA-MRSA)

- Participating in contact sports
- Living in crowded or unsanitary conditions.
- Homosexuality in men

Methicillin-resistant Staphylococcus aureus (MRSA)

- MRSA infections may affect:
  - Bloodstream
  - Lungs
  - Heart
  - Bones
  - Joints

- Serious staph infections may lead to
  - Sepsis (blood infections)
  - Endocarditis
  - Pneumonia
  - Toxic Shock Syndrome

MRSA- Treatment

- Both CA and HA associated strains of MRSA still respond to certain antibiotics.
  - In some cases, antibiotics may not be necessary.
  - For example, doctors may drain a superficial abscess caused by MRSA rather than treat the infection with drugs.

- While some antibiotics still work, MRSA is constantly adapting.

- Antibiotics that may still work are
  - clindamycin (#1 cause of C. difficile)
  - Doxycycline
  - Zyvox (20 tablets cost 1800.00)
  - Minocycline
  - Tetracycline
  - Bactrin DS or Septra DS
  - Vancomycin

MRSA- Prevention

HA-MRSA

- Quarantine
- Visitors and health care workers hygiene precautions
- Proper disinfection of surfaces

CA-MRSA

- Wash hands
- Keep wounds covered.
- Do not share personal items, such as towels.
- Shower after athletic games or practices.
- Sanitize linens.

Antibiotic Depletions

- Beneficial bacteria
  - manufacture B vitamins and vitamin K in the GI tract
  - produce proteases, lipases, and lactase that aid in digestion of nutrients
- Bifidobacteria produce SCFAs that provide from 5-10% of our daily energy supply
- Dysbiosis further disrupts digestion and absorption of nutrients

Hill, "Intestinal flora and endogenous vitamin synthesis," Eur J Cancer Prev. 1997; 6 (suppl 1): S43-5.

B-Complex

- Destruction of normal gastrointestinal flora by antibiotics can cause a decrease in the normal bacterial production and absorption of certain B vitamins including B1, B2, B3, B6, B12, biotin, inositol, and folic acid.

- Calcium, magnesium, iron, and zinc form insoluble complexes with tetracycline and fluoroquinolone antibiotics and can diminish absorption of both the antibiotic and the mineral.

Green Tea/St Johns Wort

- Green Tea Catechins
  - Fluoroquinolones can reduce the clearance of caffeine and theophylline and may increase risk of associated side effects. (nervousness, insomnia, and palpitations)

- St Johns Wort
  - Photosensitivity effect may be additive with other photosensitizing drugs including fluoroquinolones, sulfonamides or tetracyclines

Support*

- Berberine Combination t.i.d.
  - Barberry (Berberis vulgaris) Root Extract 6:1 400 mg
  - Oregon Grape (Berberis aquifolium) Root Extract 6:1 400 mg
  - Goldenseal (Hydrastis canadensis) Root and Rhizome Extract 100 mg
    - standardized to contain 5% total alkaloids including berberine, hydrastine, and canadine
- Grapefruit Seed Extract
- Garlic

* Not using antibiotics can become life threatening or damage organs

Support

- Probiotics
  - Must always be used with antibiotics
  - Take probiotic during antibiotic use but as far from antibiotic dosage as possible
  - Increase probiotic dosage after course of antibiotic for a few days at minimum
- Healthy diet
  - Low sugar and high fiber
    - Sugar feeds bad bacteria
    - Fiber feeds good bacteria

Pharmacist's Point

- Due to today's diet and busy stressful lifestyles; both that interfere with healthy flora people must supplement with probiotics.
- Is it possible that we would not see as many adverse reactions and resistant bacteria if the population had a healthier gut flora in the beginning?
- Is it possible we would not need as many antibiotics if the gut flora was providing its natural immunity to the host?
- We must start giving probiotics and the right kind before and during antibiotic usage.

Probiotics

- Must be stable- shelf life proven
- Deliver to intestines live