Challenges in the Use of Antibiotics in the Elderly

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Regional Geriatric Program of Eastern Ontario
Geriatric Refresher Day
The Challenges

- Diagnosing Infection in the Elderly
- Antibiotic Overuse
- Antibiotic Resistance
- Dosing of Antibiotics
- Adverse Effects
- Drug Interactions
- Drug Administration
- Compliance Issues
Introduction

*Why are the elderly at increased risk for infection?*

- decreased immunity
- immunosuppressive drugs
- poor nutrition
- decrease in usual protective barriers (cough, skin)
- chronic illness
- increased exposure to organisms, esp in LTCFs
- increased use of invasive devices
Diagnostic Challenges

- ‘Classic’ signs and symptoms (e.g. fever, incr WBC) may be absent
- Presentation of infection may be non-specific
  - Change in appetite, cognition; decreased functional status, delerium, agitation, lethargy, decreased oral intake, N/V, falls, incontinence, etc.
- Many other reasons for these changes
- Difficulty in interpretation of assessment
  - Lung findings, bacteruria, pyuria
- Impaired communication of symptoms
- Limited availability / use of diagnostic testing
Fever in the Elderly

- May be absent or blunted
- Presence of fever more likely to reflect serious infection
- Baseline often lower than normal
What is Fever?

- Oral temp > 37.8°C (100°F)
- Persistent temp > 37.2°C (oral, TM) or > 37.5°C (rectal) (> 2 occasions)
- > 1.1 - 1.3 °C over baseline

= trigger for *evaluation* of infection

Challenge No.2: Antibiotic Use / Overuse

- 50-80% of LTCF residents receive an antibiotic every year
- 25% - 75% of antimicrobials prescribed in nursing homes are considered inappropriate
- Incidence of 4.0 to 7.3 antibiotic courses per 1000 resident-days reported in US and Canada

JAMDA 2012;13:568.e1-e13
Antibiotic Use / Overuse

Point prevalence of antibiotic use in residents of 363 LTCFs in Ontario in 2009

- 6% of residents rec’d antibiotics on study date (range 2-11%)
- 43% had a claim for MD bedside visit; only 17% for reason related to infection
- 21% of courses > 90 days

Adverse Consequences of Antibiotic Overuse

- Antibiotic resistance
- Risk of allergic reactions
- Adverse effects
- Drug interactions
- Superinfections
  - *Clostridium difficile* infection
  - Yeast
Challenge No.3: Antibiotic Resistance

- Antibiotic resistance → a global public health threat
- Particular concerning in LTCFs
- Increased risk of hospitalization, morbidity +/- mortality & healthcare costs
- Most concerning: MRSA, VRE, fluoroquinolone resistance, multi-drug resistant (MDR) gram-negative bacteria
Reasons for Increased Risk of Resistance in the Elderly / LTCF

- Increased exposure to healthcare system
- Increased exposure to antimicrobials
- Decreased immune system
- Decreased functional status/hygiene
- Increased use of invasive devices
- Close contact with other residents, medical staff
- Adherence to Infection Control Policies?
Fluoroquinolone Resistance in Pneumococci by Risk Factor

Toronto Invasive Disease Bacterial Network
Most Common Infections in Nursing Home Residents

- UTI: 32%
- Resp Tract: 33%
- Skin: 13%
- Other: 12%
- Unspecified: 10%

Challenge: Better UTI Diagnosis

UTI accounts for the largest proportion of inappropriate antibiotic use in LTCFs
UTIs in the Elderly

- Account for ≈ 25% of infections in elderly in the community
- 2nd most frequent cause of infection in LTCFs
- Catheter use associated with increased risk for mortality from UTI
<table>
<thead>
<tr>
<th>UTI True/False</th>
<th>True or False</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine should be cultured if cloudy or if smelly / foul smelling</td>
<td></td>
</tr>
<tr>
<td>The presence of bacteria in the urine is abnormal in the elderly</td>
<td></td>
</tr>
<tr>
<td>An individual with a positive urine culture should always receive antibiotics</td>
<td></td>
</tr>
<tr>
<td>A urinalysis / R&amp;M should always be performed when diagnosing a UTI</td>
<td></td>
</tr>
<tr>
<td>The presence of pyuria (pus) in the urine (WBC or positive leukocyte esterase) means antibiotics should be prescribed</td>
<td></td>
</tr>
<tr>
<td>The absence of pus or bacteria in the urine rules out a urinary tract infection</td>
<td></td>
</tr>
<tr>
<td><strong>UTI True/False</strong></td>
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</tr>
<tr>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>In the absence of fever/local symptoms, these are usually a result of dehydration and do not in themselves warrant urine cultures</td>
<td>True or False</td>
</tr>
<tr>
<td>10% of elderly men and 20% of women in the community have bacteria in the urine; 30%-50% of frail, LTC residents can have a positive urine culture</td>
<td>True or False</td>
</tr>
<tr>
<td>Asymptomatic bacteriuria does not require treatment. Only individuals with symptoms should be treated (local sx in pts without a catheter)</td>
<td>True or False</td>
</tr>
<tr>
<td>But a positive dip is not a diagnosis; also need a positive culture with other signs/symptoms</td>
<td>True or False</td>
</tr>
<tr>
<td>&gt; 90% of individuals with asymptomatic bacteriuria will have pyuria</td>
<td>True or False</td>
</tr>
<tr>
<td>Non-specific and non-localizing signs and symptoms are seldom due to a UTI in the noncatheterized resident</td>
<td>True or False</td>
</tr>
</tbody>
</table>
## UTI: True/False
### Catheterized Patients

<table>
<thead>
<tr>
<th>Statement</th>
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<tbody>
<tr>
<td>Individuals with a chronic indwelling catheter will always have bacteria in their urine</td>
<td></td>
</tr>
<tr>
<td>Treating these pts with antibiotics will prevent subsequent bacteriuria and/or symptomatic infection</td>
<td></td>
</tr>
<tr>
<td>Presence of urinary catheter increases risk for fever and bacteremia from urine source</td>
<td></td>
</tr>
<tr>
<td>Fever is the most common symptom in catheterized pts with a UTI</td>
<td></td>
</tr>
<tr>
<td>60% of patients with a catheter and fever have a UTI</td>
<td></td>
</tr>
<tr>
<td>Removing/changing the foley catheter before starting antibiotic therapy may be of benefit</td>
<td></td>
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</tbody>
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## UTI: True/False

### Catheterized Patients

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<td>Individuals with a chronic indwelling catheter will always have bacteria in their urine</td>
<td>True or False</td>
</tr>
<tr>
<td>No benefit to treating bacteria in the urine in the absence of symptoms, but increased risk of resistant bacteria</td>
<td>True or False</td>
</tr>
<tr>
<td>Bacteremia is 40 x more common in catheterized individuals than non-catheterized; CAUTI most common source of bacteremia in LTCF</td>
<td>True or False</td>
</tr>
<tr>
<td>Fever is the most common symptom in catheterized pts with a UTI</td>
<td>True or False</td>
</tr>
<tr>
<td>Fever is due to a UTI in 1/3 of patients with a fever and a catheter</td>
<td>True or False</td>
</tr>
<tr>
<td>This may decrease the time to response and/or decrease rate of relapse (removing source of biofilm)</td>
<td>True or False</td>
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</table>
Principles of UTI Diagnosis

- Presence of bacteria in the urine (positive culture) does not = infection
- A negative culture rules out infection
- Always do a urinalysis / R&M
  - Pyuria (WBC or leucocyte esterase (LE)) does not = infection
  - No pyuria rules out infection (dip neg for LE)
- If inadequate response in 72 h, consider obstruction, complicated disease, resistant organism, or different diagnosis
**UTI Diagnostic Algorithm**

- Fever of $>37.9^\circ C (100^\circ F)$ or $1.5^\circ C (2.4^\circ F)$ increase above baseline on at least two occasions over the last 12 h?
  - **YES**
    - 2 or more symptoms/signs of non-urinary infection**?**
      - **YES**
        - Do not order urine culture
      - **NO**
        - Order urine culture for one or more of the following:
          - dysuria
          - urinary catheter
          - urgency
          - flank pain
          - shaking chills
          - urinary incontinence
    - **NO**
      - Urinary Catheter?
        - **YES**
          - Order urine culture for one or more of the following:
            - new costovertebral tenderness
            - rigors
            - new onset of delirium
        - **NO**
          - Order urine culture for new onset burning urination or for two or more of the following:
            - urgency
            - flank pain
            - shaking chills
            - urinary incontinence

* Respiratory symptoms include increased shortness of breath, increased cough, increased sputum production, new pleuritic chest pain.
Gastrointestinal symptoms include nausea/vomiting, new abdominal pain, new onset of diarrhea.
Skin/soft tissue symptoms include new redness, warmth, swelling, purulent drainage.
UTI Treatment Algorithm

Results of the urine culture?

> 10⁵ CFU/mL (positive) OR Pending

Urinary catheter?

YES

Is there 1 or more of the following?
- new costovertebral tenderness
- rigors
- new onset of delirium
- fever*

NO

Is there dysuria or 2 or more of the following?
- fever*
- urgency
- flank pain
- urinary incontinence
- shaking chills

If yes, begin antibiotics†
If no, do not treat for UTI

Negative (no growth or mixed)

No UTI

* >37.9°C (100°F) or 1.5°C (2.4°F) above baseline on 2 occasions over the last 12 h.
† Stop antibiotics if urine culture is negative or no pyuria.
UTI Clinical Pathway

TOP Program
Edmonton, Alta
Minimum Criteria for Initiation of Antibiotics in Long-Term Care Residents

Suspected Urinary Infection

- **NO indwelling catheter**
  
  *need either:*
  - Acute dysuria
  - or
  - Fever >38.9°C (102°F)
  *and at least one* of the following:
  - Urgency
  - Frequency
  - Suprapubic pain
  - Hematuria
  - Costovertebral tenderness
  - New onset urinary incontinence

- **WITH indwelling catheter**
  
  *need at least one* of the following:
  - Fever >38.9°C (102°F)
  - New costovertebral tenderness
  - Rigors
  - New onset of delirium
Pneumonia in the Elderly

- Higher incidence/mortality rate vs younger pts
- 2nd most frequent cause of hospitalization

For residents of LTC facilities:
- pneumonia is 10 times more frequent than healthy ambulatory older adults
- pneumonia is leading reason for transfer to acute care.
- leading cause of morbidity and mortality

Pneumonia Diagnosis

- Symptoms may include fever, new or increased cough with sputum production, dyspnea, new lung findings, increased RR, etc.

- If resp rate >25, check oxygen level (pulse oximetry)

- CXR useful to rule out other diagnosis (e.g., CHF)
Pneumonia Algorithm

LTDCF Resident with ≥ 2 Symptoms/Signs:
1. New or increased cough
2. New or increased sputum production
3. Fever (≥38°C)
4. Pleuritic chest pain
5. New or increased findings on chest examination

Order Mobile Chest X-Ray (For Diagnosis of Pneumonia)

LTDCF Management Criteria:
- Resident is able to eat and drink?
- Pulse ≤ 100?
- Respiratory Rate < 30 min?
- BP ≥ 90 systolic (decrease 20 mm Hg)?
- Oxygenation ≥ 92% (≥90% for COPD)?

YES

Management on site in LTDCF
- Levofloxacin 500 mg/d orally X 10d
- Fluid status assessed by research nurse
- Rehydration using hypodermoclysis
- Transfer to hospital if management criteria are no longer met

NO

Transfer to hospital
- Levofloxacin 500 mg/d orally X 10d
- List of indications outpatient investigation provided
- Discharge back to LTDCF when LTDCF criteria met

Pressure Ulcers

- Infectious S/S (prompting cultures)
  - Wound worsening despite appropriate care
  - Purulent drainage
  - Cellulitis (redness, pain, warmth, swelling) of surrounding tissues

- Cultures: from drainage inside wound or tissue at debridement
Diarrhea

- Many causes
  - Drugs (including antibiotics!)
  - Symptoms of remote infections (pneumonia, bacteremia, GI)
  - Viruses
  - Bacteria (food borne) — fever, cramping, WBC or RBC in stool

- If antibiotic tx in last 6 weeks, or if severe, check stool for *C. difficile* toxin
Antibiotic Stewardship in Long Term Care

- Develop/follow guidelines for initiating antibiotics
- Communicate all signs/symptoms (new or worsened) of infection to physician
- Consider non-infectious causes
- Discriminate b/w colonization and infection
- Obtain cultures before antibiotics started
- Preventative measures
Antibiotic Stewardship in Long Term Care

- Obtain/provide history of recent antibiotic use
- Change class of agent when possible and appropriate
  - Esp. fluoroquinolones within previous 3 months, macrolides for respiratory tract infections
  - Consider beta-lactam alternatives, including IM ceftriaxone
- Attention to stop dates / duration of therapy
- Question role of prophylaxis
Challenge No.4: Antibiotic Dosing

- Physiologic changes = unpredictable drug levels and action in body
  - renal excretion most significant
- Elderly usually excluded from studies
- Increase risk of toxicity
- Equations used to estimate renal function not accurate in the elderly
  - uses serum creatinine (from muscle)
  - concern of overestimation
Antibiotic Dosing in the Elderly

- “Start low, go slow” not necessarily better with antibiotics
- Generally, use the usual adult dose regimen
- Adjust for renal function
- Adjust for weight (esp < 45 kg)
- Most antibiotics need dose adjustment in renal dysfunction **except:**
  - cloxacillin, ceftriaxone, azithromycin, doxycycline, moxifloxacin

Challenge No. 5: Adverse Effects

- The elderly are at increased risk of adverse drug reactions (ADR)
  - increased exposure due to changes in drug pharmacokinetics
  - increased sensitivity of some organs to drugs
  - polypharmacy

- Antibacterials a frequent cause of ER visits due to ADRs, esp. in elderly
  - 17% of ED visits from ADEs due to antibiotics (Ann Emerg Med 2001;38:666–71.)
  - Antimicrobial drugs > independent risk factor for an ADE than drugs from many other classes in nursing home residents (Arch Int Med 2001;161:1629-34.)
Esophageal Injury

- “Sticking” of pills in esophagus
- Increased risk in elderly
- Symptoms: sudden onset difficulty swallowing, painful swallowing and/or retrosternal pain
- Transient, self limiting inflammation to severe ulceration / perforation or stricture
- Antibiotics implicated: tetracyclines (e.g., doxycycline), clindamycin, rifampin, azithromycin
- Ensure sufficient water and not immediately prior to lying down/bedtime
Challenge No. 6: Drug Interactions

- An estimated 39% of elderly in the community take $\geq 5$ meds
- Polypharmacy is even more common in residents of LTCFs
- Pharmacokinetic (change in drug levels) vs pharmacodynamic (effects on action of drug)

FQ = fluoroquinolones (cipro-, levo-, moxi-, nor-, o-floxacin)
Macrolides = erythromycin, clarithromycin, azithromycin*
(* less propensity for interactions)

<table>
<thead>
<tr>
<th>Interacting Drug</th>
<th>Antibiotic(s)</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfarin</td>
<td>Macrolides, FQ, metronidazole, septra;</td>
<td>↑ effect of warfarin — monitor INR</td>
</tr>
<tr>
<td>Anti-arrhythmics; other drugs that prolong QT interval</td>
<td>Macrolides, FQ</td>
<td>Risk of torsades de pointes; watch electrolytes</td>
</tr>
<tr>
<td>Cations (e.g. calcium, Mg++, iron, Al++, zinc)</td>
<td>FQ, tetracyclines</td>
<td>↓ abx levels; adequately space administration</td>
</tr>
<tr>
<td>Statins (simvastatin, atorvastatin, lovastatin)</td>
<td>Macrolides</td>
<td>↑ statin levels; muscle toxicity</td>
</tr>
<tr>
<td>Serotonergic drugs (e.g. SSRI antidepressants, tramadol)</td>
<td>Linezolid (Zyvoxam®)</td>
<td>Risk of serotonin syndrome (tremor, fever, GI, confusion, delerium, agitation, stiffness)</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Macrolides, trimethoprim (in septra), tetracyclines</td>
<td>Possible ↑ digoxin levels; risk of toxicity</td>
</tr>
<tr>
<td>Sulfonylureas (e.g. glyburide)</td>
<td>Septra</td>
<td>↑ hypoglycemic effect</td>
</tr>
<tr>
<td>Calcium Channel blockers (i.e., diltiazem, verapamil)</td>
<td>Macrolides</td>
<td>↑ effects of CCB; monitor HR, BP</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>Metronidazole, septra Ciprofloxacin</td>
<td>↑ phenytoin levels—monitor possible ↓ phenytoin levels</td>
</tr>
<tr>
<td>Antibiotic(s)</td>
<td>Interacting Drug</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Macrolides</td>
<td>Warfarin, statins (simvastatin, atorvastatin, lovastatin) CCB, drugs that prolong the QT interval, digoxin</td>
<td></td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>Cations (e.g. calcium, Mg++, iron, Al++, zinc), warfarin, drugs that prolong the QT interval, phenytoin (cipro)</td>
<td></td>
</tr>
<tr>
<td>Septra</td>
<td>Warfarin, sulfonylureas, ACE Inhibitors, ARBs, K+ supplements, digoxin, phenytoin</td>
<td></td>
</tr>
<tr>
<td>Rifampin</td>
<td>Phenytoin, warfarin, certain steroids, + many many more!! <strong>Always check!</strong></td>
<td></td>
</tr>
<tr>
<td>Linezolid</td>
<td>Serotonergic drugs (e.g. SSRI antidepressants, tramadol)</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Warfarin, phenytoin</td>
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</tbody>
</table>

CCB: calcium channel blockers (e.g. verapamil, diltiazem)  
ARBs: angiotensin blocking agents (“sartans”)  
SSRI: selective serotonin reuptake inhibitors (e.g. sertraline, citalopram)
## Most Common Antibiotics Prescribed in Ontario LTCFs

<table>
<thead>
<tr>
<th>Antibiotic name</th>
<th>Number of antibiotic treatment courses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrofurantoin</td>
<td>365 (15.4)</td>
</tr>
<tr>
<td>Trimethoprim/sulfamethoxazole</td>
<td>338 (14.3)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>304 (12.8)</td>
</tr>
<tr>
<td>Cefalexin</td>
<td>241 (10.2)</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>235 (9.9)</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>134 (5.7)</td>
</tr>
<tr>
<td>Norfloxacin</td>
<td>123 (5.2)</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>105 (4.4)</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>83 (3.5)</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>73 (3.1)</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>73 (3.1)</td>
</tr>
<tr>
<td>Cloxacillin</td>
<td>59 (2.5)</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>56 (2.4)</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>47 (2.0)</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>36 (1.5)</td>
</tr>
<tr>
<td>Cefprozil</td>
<td>22 (0.9)</td>
</tr>
<tr>
<td>Penicillin</td>
<td>17 (0.7)</td>
</tr>
<tr>
<td>Cefixime</td>
<td>16 (0.7)</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>12 (0.5)</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>10 (0.4)</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>10 (0.4)</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>≤5 (0.2)</td>
</tr>
<tr>
<td>Cefaclor</td>
<td>≤5 (0.1)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2366 (100)</strong></td>
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# Most Common Antibiotics Prescribed in Ontario LTCF

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<th>Antibiotic Name</th>
<th>Number of Antibiotic Treatment Courses (%)</th>
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<tr>
<td>Fluoroquinolones</td>
<td>28%</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>338 (14.3)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>304 (12.8)</td>
</tr>
<tr>
<td>Beta-lactams (penicillins/cephs)</td>
<td>27%</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>134 (5.7)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>83 (3.5)</td>
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<tr>
<td>Cefuroxime</td>
<td>73 (3.1)</td>
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<tr>
<td>Nitrofurantoin</td>
<td>15%</td>
</tr>
<tr>
<td>Septra</td>
<td>14%</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>56 (2.4)</td>
</tr>
<tr>
<td>Macrolides (clari, azi)</td>
<td>6%</td>
</tr>
<tr>
<td>Cefprozil</td>
<td>22 (0.9)</td>
</tr>
<tr>
<td>Penicillin</td>
<td>17 (0.7)</td>
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Fluoroquinolones

Norfloxacin, levofloxacin, moxifloxacin, ciprofloxacin

- Pneumonia (levo, moxi), UTI (norflox, cipro, levo)
- Uncomplicated UTI (cystitis): 250 mg doses
- Cardiac toxicity (QT)
- Tendinitis / tendon rupture
- Hypoglycemia
- CNS: headache, confusion, tremor, dizziness, anxiety, insomnia, hallucinations (esp >80 yo; dose not renally adjusted)
Beta-Lactam Agents

Includes penicillins, cephalosporins, carbapenems

- Well tolerated
- Main side effects: allergy, GI, rash
- Amox/clav: ↑ risk diarrhea, liver toxicity
- IM ceftriaxone; IM ertapenem
- Most renally excreted, exc. cloxacillin, ceftriaxone
- 3rd Generation cephalosporins (e.g. ceftazidime, cefepime): concern for non convulsive status epilepticus, esp without dose adjustment
Nitrofurantoin

- Effective for **bladder infections** with *E. coli* and Enterococcus sp.

- Decreased activity with decreased renal function
  - Cutoff: CrCl $\leq 60$ ml/min vs $40$ ml/min ??
  - Concern of serious liver, lung toxicity with longer term treatment (e.g., prophylaxis)
  - Peripheral neuropathy

- Only anti-infective on the Beers criteria: ‘should generally be avoided in elderly’

Septra

- Decreased tolerance in elderly
- Increased risk of rash, liver toxicity, bone marrow toxicity e.g., decrease in WBC, plts
- Hypoglycemia
- Hyperkalemia; esp in pts on ACE inhibitors, K+ supplements
- Adequate hydration
- Interactions (warfarin, sulfonylureas)
Macrolides

- Erthromycin, clarithromycin, azithromycin
- SE: GI** (abnormal taste, nausea, cramping, vomiting, diarrhea)
- Liver
- QT prolongation (azithro less)
- Drug interactions (azithro less)
Aminoglycosides

- Gentamicin, tobramycin, amikacin
- IM or IV only
- Role for seriously ill; MDR UTIs, esp upper UTI
- Increased risk of toxicity vs other agents
- Nephrotoxicity, ototoxicity: inc risk in elderly, dehydration, pre-existing renal dz
- Needs monitoring!! Scr (2-3 x / week), levels
- Renally eliminated; need dosing adjusted; lower doses (1-3 mg/kg daily)
Challenge No.7: Drug Administration

- Limited use of parenteral (IV, IM) routes
- Drugs with good systemic levels include fluoroquinolones (moxi, levo, cipro), septra
- Not macrolides, beta-lactams
- Ceftriaxone, ertapenem IM with lidocaine
- Aminoglycosides IM (e.g., gentamicin)
- Absorption issues: take with food vs empty stomach; interaction with cations
Challenge No.8: Compliance

- Polypharmacy
- Fear of interactions
- Inability to follow directions
- Poor comprehension/memory
- Cost
- Adverse effects
- Unable to open
Summary

- Numerous challenges associated with antibiotic use exist in the elderly
- Antibiotics can be life saving drugs, but also carry significant potential harms
- Risks of adverse effects and antibiotic resistance can be minimized in the elderly by:
  - Appropriate dosing in patients with decreased renal/liver function
  - Attention to drug interactions, esp. in patients on multiple medications
  - Use of guidelines for initiation of antibiotics in LTCFs