Injectable Acetaminophen: What is its role in postoperative pain management?

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Palos Community Hospital

Additional Goals

By the end of this knowledge-based educational activity, participants should be able to:

1. Explain the clinical and economic consequences of inadequate control of postoperative pain.
2. Identify elements of multimodal postoperative analgesia.
3. Discuss clinical data for using injectable acetaminophen for management of postoperative pain.
4. Describe the practical aspects of utilizing injectable acetaminophen within the acute care setting.

Impact of Postoperative Pain

- **Negative CLINICAL Outcomes:**
  - Cognitive dysfunction
  - Coronary ischemia / myocardial infarction
  - Deep vein thrombosis / pulmonary embolism
  - Insomnia
  - Pneumonia
  - Poor wound healing and recovery


Postoperative Pain: Link to Chronic Pain

- **Retrospective analysis**
- **Evaluated patients undergoing thoracotomy who developed chronic pain (n = 78) vs. those who did not (n = 71) one week postop**
  - Patients who developed chronic pain had increased...
    - ↑ incidence of acute pain (p = 0.002)
    - ↑ severity of acute pain (p = 0.0001)
    - ↑ total time having pain (p = 0.02)
  - Progression to chronic pain increased with intensity of acute postoperative pain


Disclosures

The speaker has no actual or potential conflict of interest in relation to this presentation.

Palos Community Hospital

- Located in southwest suburbs of Chicago, IL
- Community, non-teaching
- 436 licensed beds
- Pharmacy satellite in OR

**2011 surgical statistics**
- Inpatient procedures: 3,993
- Outpatient procedures: 4,575
Impact of Postoperative Pain

- Pilot prospective cohort study
- Purpose was to describe postoperative pain and health-related QOL, and functioning 1 month after hospital discharge
- Participants underwent radical prostatectomy (RP), total hip replacement (THR), or total knee replacement (TKR), and completed the SF-36 and questions from the Treatment Outcomes of Pain Survey (TOPS) 4 weeks after leaving the hospital
  - N = 30 (RP = 15, THR = 8, THR = 7)
- Postoperative pain interfered with patient’s ability to participate in desired activities (42.9% RP, 28.6% THR, 100% TKR), ability to sleep (21.4% RP, 71.4% THR, 75% TKR), and sexual functioning (50% RP, 28.6% THR, 25% TKR). During the first month after surgery, post-op pain contributed to diminished health-related QOL and interfered with activities important to patients. Mean SF-36 scale scores in each surgical group were lower than US norms for physical functioning, physical role, bodily pain, vitality and social functioning.

Opioid Adverse Events

- Historically, opioid monotherapy primary treatment of postoperative pain
- 24 – 48 hours postoperatively: morphine or hydromorphone
- PCA followed by oral hydrocodone, morphine, or oxycodone
- In a systematic review of several randomized controlled trials analyzing opioid-associated ADEs in postop patients, more than 30% of patients reported GI ADEs
  - Most common: vomiting, constipation, and ileus
  - Most severe ADEs reported: sedation and resp depression

Multimodal Analgesia

- Use of different classes of analgesics that employ different pathways AND receptors to provide pain relief
- Ideal components of multimodal analgesia include:
  - Agents with ability to modulate 2 mechanism of pain transmission
  - Agents with an acceptable safety profile
  - Availability of an analgesic in a non-oral formulation
- Multimodal analgesia includes the use of local and systemic pharmaceutical agents in addition to perineural blockade and regional anesthesia

WHO Pain Ladder

Multimodal Analgesia

American Society of Anesthesiologists – 2012 Practice Guideline:

• The consultants and ASA members strongly agree that whenever possible, anesthesiologists should use multimodal pain management therapy. The ASA members agree and the consultants strongly agree that APAP should be considered as part of a postoperative multimodal pain management regimen; both the consultants and ASA members agree that COX-2 inhibitors, nonselective NSAIDs, and calcium channel 2· antagonists (gabapentin and pregabalin) should be considered as part of a postoperative multimodal pain management regimen. Moreover, the ASA members agree and the consultants strongly agree that, unless contraindicated, patients should receive an around-the-clock regimen of NSAIDs, COX-2 inhibitors, or APAP.


Active Learning Assessment

Jeopardy

A concept that utilizes multiple classes of medications with acceptable safety profiles that employ different pathways and receptors to provide relief of pain.

What is multimodal analgesia?

Acetaminophen

- Oral formulation available in US since 1955
- IV formulation approved by FDA in November 2010 for use in (pain, fever)
- Recognized as safe and effective at recommended doses

Dosage and Administration

<table>
<thead>
<tr>
<th>IV APAP</th>
<th>Oral APAP</th>
<th>Rectal APAP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>50 mg: 1 gm q4h or 650 mg q4h (Max 4 gm/day)</strong></td>
<td>Adults: 650 mg or 1 gm q4–6h or 1.3 gm ER tablets q4h PRN (Max 4 gm/day)</td>
<td>Adults: 325–650 mg q4h PRN</td>
</tr>
<tr>
<td>&lt; 50 kg or ages 2–12</td>
<td>Children aged &lt; 12: weight-adjusted dose 160–480 mg q4h (Max 5 doses/day)</td>
<td>Children aged &lt; 2: individualized</td>
</tr>
<tr>
<td>15 mg/kg q4h or 12.5 mg/kg q4h (Max 75 mg/kg/day)</td>
<td>Children aged &lt; 12: weight-adjusted 40–480 mg q4–6 h (Max 5 doses/day)</td>
<td><strong>Formulation</strong></td>
</tr>
<tr>
<td>15 min infusion</td>
<td></td>
<td>1 gm/100 mL SDV</td>
</tr>
</tbody>
</table>

Pharmacokinetics

Absorption
- Peak concentration is observed at the end of infusion

Distribution
- Mean Vd reported in several studies has ranged from 69.2 – 85 L; not extensively plasma protein-bound (10% to 25%)

Elimination
- Half-life is 2.4 hours in adults, 2.9 hours in adolescents, 1.5 to 3 hrs in children, 4.2 hrs in infants

Pharmacodynamics

• Analgesic effect of APAP involves both central and peripheral actions
  - Inhibition of nitric oxide synthesis pathway
  - Inhibition of prostaglandin synthesis
  - Analgesic effects of paracetamol may also involve the serotonergic system


Duggan ST, Scott LJ. Intravenous paracetamol (acetaminophen). Drugs. 2006; 69 (3): 101-113


Safety Profile

- Amar et al confirmed that doses > 4 grams per day may cause centrilobular hepatic necrosis in adults
  - Administration of scheduled doses for more than a few days requires caution
- Singla et al compared the safety profile of IV APAP (1 gm q6h and 650 mg q4h) with the standard-of-care in 213 patients.
  - A lower proportion (~15% vs. 26.7) of patients with elevated LFTs in the IV APAP groups compared with the control group

Meta - Analyses

- Rampling et al evaluated the analgesic effect of rectal, IV, and oral formulations of APAP was evaluated (24 studies, 2023 patients)
  - APAP, given either rectally or IV, was effective for post-op pain relief
  - Addition of NSAIDs to APAP predictably improved pain relief, whereas adding APAP to NSAIDs was less predictable
- Remy et al and Elia et al evaluated outcomes of APAP (IV, PO, and PR) in combination with PCA after orthopedic and abdominal surgery
  - 7 trials (491 patients) and 10 trials (769 patients), respectively
  - Compared with placebo, APAP given post-op significantly reduced morphine requirements by ~20% (8-10 mg) on post-op Day 1
  - Not associated with a significant reduction in post-op N/V, sedation, urinary retention, and respiratory depression

Active Learning Assessment

LA is a 92 year old male with a PMH significant for colon polyps, gastric ulcers, hypertension, hyperlipidemia, atrial fibrillation – s/p pacemaker recently diagnosed with early stage colon CA. He is admitted for a partial colectomy and your medical team asks you what the BEST postoperative analgesic regimen would be for this patient. He is allergic to morphine (itching).

HINT: Your formulary analgesics include IV and PO APAP, celecoxib, fentanyl IV and TD, hydrocodone, hydromorphone, PO ibuprofen, ketorolac, morphine, and oxycodone.

IV Acetaminophen DUE

<table>
<thead>
<tr>
<th>Inclusion</th>
<th>Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥18 year of age</td>
<td>Allergy or hypersensitivity to APAP</td>
</tr>
<tr>
<td>General surgical procedures</td>
<td>Transamminoses &gt; 2 x ULN</td>
</tr>
<tr>
<td>Inpatient at least 24 hours post-op</td>
<td>SID &gt; 2 mg/dL</td>
</tr>
<tr>
<td>Received minimum 2 doses of IV APAP</td>
<td>Uncontrolled chronic disease</td>
</tr>
<tr>
<td>Body weight 50-120 kg</td>
<td>History of alcohol or drug abuse</td>
</tr>
<tr>
<td>Numeric pain scale used (1-10)</td>
<td>Pregnancy or breastfeeding</td>
</tr>
<tr>
<td>ASA class 1-3</td>
<td>Treatment of fever</td>
</tr>
</tbody>
</table>

Primary endpoint
- Total morphine and NSAID equivalent dose during first 24 hours

Secondary endpoints
- PACU LOS and pain score reduction

IV Acetaminophen DUE

Results
- ↓ total opioid use by 24%
- ↓ total NSAID use by 100%
- ↓ their total pain score by 9%
- Did NOT reduce their PACU length of stay

Limitations
- retrospective, observational study
- IV APAP was not available in OR
- Not all patients received IV APAP as a scheduled med
- IV APAP group received higher doses of total fentanyl, midazolam, dexamethasone and ketorolac
Impact on Med-Use Process

Prescribing
- Which dose...650 mg or 1000 mg (adults)?
- Dose calculation required for pediatrics
- Scheduled vs. PRN
- Restrictions to specialists, units, or patient types?

Dispensing
- Doses < 1000 mg require manipulation
- Contents of vial must be administered within 6 hrs
- Adequate space in automated dispensing machine (ADM)?

Impact on Med-Use Process

Adminstration
- Infusion pump required
  - Errors related to infusion pump programming have been reported
    to the Institute for Safe Medication Practices (ISMP)
    
    > ISMP recommends use of both mg and mL dosing when
      prescribing and communicating dose information

- Y-site compatibility for patients with multiple infusions

Impact on Med-Use Process

Monitoring
- Ensure use of < 4 grams per day of APAP
  - Hold use of combo APAP products 24 to 48 hours post-op
    > FDA requiring manufacturers to limit APAP in prescription
      products to 325 mg per single dosage unit and add a black-
      box warning by 2014

- Cost-effectiveness
- IV to PO conversion
- Automatic stop dates/times, e.g. 24 hours after 1st dose

Impact on Med-Use Process

Active Learning Assessment
Which of the following are issues that must be addressed when evaluating IV APAP for formulary addition?

I. Ensuring patients do not receive > 4 gm APAP per 24 hrs
II. Manipulation of vials when doses are less than 1 gm
III. Risk of infusion pump errors if doses not ordered in mg and mL
   a. I only
   b. III only
   c. I and II
   d. II and III
   e. I, II, and III

Conclusions

- IV APAP is generally well tolerated at recommended doses
- Clinical trials indicate IV APAP is an effective analgesic in a
  variety of inpatient and outpatient surgical procedures
- Use should be limited to ≤ 24 hours postoperatively and
  patients who can not tolerate PO or PR administration
- Institution-specific strategies are required to ensure safe use of
  IV APAP
References

Bibliography

Society of Regional Anesthesia Meeting and Workshops. April 30 to May 3, 2009; Phoenix, AZ. Poster 96.
Decisions, Decisions...Debates in Therapeutics

INTRAVENOUS ACETAMINOPHEN
A DRUG UTILIZATION EVALUATION

Jamie Brockhouse
St John’s Hospital
Springfield, Il

Conflict of Interest Declaration
The speaker has no actual or potential conflict of interest in relation to this activity

Learning Objective
• Upon completion of this program, pharmacists should be able to:
  – Describe the role in therapy for IV acetaminophen

Additional Goal:
  – Compare the advantages and disadvantages for IV acetaminophen

Question
• Does your organization restrict the use of IV Acetaminophen?

Post Surgical Pain Management: Our Current Approach
• Surgical pain mechanism
  – Inflammation as a result of tissue trauma
  – Direct nerve damage
• Multimodal analgesia
  – Involvement of several different disciplines
  – Goal: maximize pain relief, minimizing side effects and contain cost
• Most commonly used pharmacologic agents
  – Opioids
  – NSAIDs

Advantages and Disadvantages to Current Approach
• Advantages
  – Dosing flexibility
  – Multiple routes of administration
  – Low cost
• Disadvantages
  – Nausea and vomiting
  – Slowing of GI transit
  – Constipation/post op ileus
  – Depression of brainstem control of respiratory drive
  – Histamine release
  • itching
A New Approach
IV Acetaminophen

• Proposed Benefits
  — Decreased utilization of morphine equivalents
  — Less opioid-related adverse effects
  — Earlier mobilization
  — Increased physical therapy participation
  — Decreased risk of DVT
  — Decreased length of stay
  — Reduction of hospital cost
  — Increased patient satisfaction

• Disadvantages
  — Packaging
    • Glass bottle difficult to store in ADM
  — Potential for drug waste
    • Only available as 1000mg dose
    • Wt <50kg requires weight based dosing (15mg/kg)
  — Fluid restricted patients
    • 100ml of fluid per dose
  — Only available as 1000mg dose
  — Wt <50kg requires weight based dosing (15mg/kg)
  — After manipulation stability is 6 hours
  — Side effects observed
    • Nausea/vomiting
    • Headache

• Kinetics
  — Tmax: more predictable than other routes of acetaminophen
  — Analgesic effect of multiple routes similar
  — Analgesic effect of rectal formulation prolonged

• Analgesic effect of rectal formulation prolonged

• Patient selection
  — Contraindicated with severe liver impairment or acute liver disease
  — Use with caution:
    • Alcoholism, malnutrition, hepatic impairment, renal impairment (CrCl <30ml/min)

• Patient safety
  — Account for acetaminophen from all sources
  — Minimum of 4-6 hours prior to administration of APAP-containing combination products

Our Current Practice
IV Acetaminophen

• Restricted Use
  — Surgical unit
    • Including cesarean sections
  — Post-op orthopedics
  — Limited duration 24 hours

IV Acetaminophen – Pain Scores

<table>
<thead>
<tr>
<th></th>
<th>Received IV APAP</th>
<th>Did not receive IV APAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average of pre-surgery pain score</td>
<td>2.6</td>
<td>1.72</td>
</tr>
<tr>
<td>Average of pain score 6 hours after surgery</td>
<td>2.55</td>
<td>3.8</td>
</tr>
<tr>
<td>Average of pain score 12 hours after surgery</td>
<td>4.00</td>
<td>4.9</td>
</tr>
<tr>
<td>Average of pain score 24 hours after surgery</td>
<td>5.19</td>
<td>4.1</td>
</tr>
</tbody>
</table>

• 100 patients received IV APAP (average of 2.5 doses) during their stay (Feb 2012-July 2012)
• 89 patients received no IV APAP during their stay (Oct 2011-Jan 2012)
IV Acetaminophen – Average Length of Stay and Charges

<table>
<thead>
<tr>
<th>Month</th>
<th>ICD-9 Code</th>
<th>IV APAP Used</th>
<th>Average Length of Stay</th>
<th>Average Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2012</td>
<td>715.36</td>
<td>Yes</td>
<td>2.68 days</td>
<td>$36,100</td>
</tr>
<tr>
<td>May 2011</td>
<td>715.36</td>
<td>No</td>
<td>2.88 days</td>
<td>$35,600</td>
</tr>
<tr>
<td>May 2012</td>
<td>715.35</td>
<td>Yes</td>
<td>2.56 days</td>
<td>$42,600</td>
</tr>
<tr>
<td>May 2011</td>
<td>715.35</td>
<td>No</td>
<td>3.00 days</td>
<td>$42,500</td>
</tr>
<tr>
<td>May 2012</td>
<td>654.21</td>
<td>Yes</td>
<td>2.56 days</td>
<td>$7,700</td>
</tr>
<tr>
<td>May 2011</td>
<td>654.21</td>
<td>No</td>
<td>2.40 days</td>
<td>$7,600</td>
</tr>
</tbody>
</table>

IV Acetaminophen – Multiple Dosing

• 15 patients who received multiple doses of IV APAP (average of 3.23 doses) were randomly selected and compared to 15 patients who received a single dose of IV APAP.

Review

• What positives do you see from IV Acetaminophen use?
• What negatives do you see from IV Acetaminophen use?
• What additional research data would you like to see about IV Acetaminophen use?

Conclusion

• Place in therapy is undetermined
  – Results of our DUE failed to demonstrate that clinical advantages outweigh the economic burden
• Additional research needed
  – Larger sample size
  – Time to first physical therapy
  – Frequency of nausea and vomiting
• Needs to be proven fiscally responsible
  – Anticipated benefits must be observed

Assessment Question

Which of the following statements is/are true regarding the infusion of intravenous acetaminophen?
A. Infusion time is 30 minutes
B. Cmax occurs at 30 minutes
C. Overall AUC is similar to oral administration
D. After penetration of the seal the product should be used within 12 hours
E. All of the above

Questions

we believe
in inspired care.

St. John’s Hospital
References


Decisions, Decisions... Debates in Therapeutics

Bupivacaine liposomal injection
Will it stick around?

Elizabeth Short, Pharm.D.
PGY2 Critical Care
Northwestern Memorial Hospital

Conflicts

• I have no conflicts of interest to declare

Additional Goals

• Determine criteria necessary for formulary approval

• Interpret clinical trial data and apply to formulary management

Bupivacaine liposome injectable suspension (Exparel™)

Approved Indication:
For administration into the surgical site to produce postsurgical analgesia

Formulary Criteria

• Efficacy

• Safety

• Avoid superfluous, expensive additions

Bupivacaine liposome injectable suspension (Exparel™)

• Pacira Pharmaceuticals, Inc.

• FDA Approval: October, 2011

• Intended to provide longer duration of effect

Bupivacaine liposome injectable suspension (Exparel™)

Multivesicular Liposomes

FDA Approval

Based on two clinical trials
• Bunionectomy (Golf 2011)
• Hemorrhoidectomy (Gorfine 2011)

Efficacy

Primary efficacy endpoint:
Pain intensity score summation over time

Efficacy

Primary efficacy endpoint:
Pain intensity score summation over time

No benefit beyond 24 hours

Percentage of Patients Pain-free vs Hours

No Opioid Rescue Medications vs Hours
Cumulative Pain Score through 72 Hours

Mean Total Amount of Opioids Over 72 Hr

No Opioid Rescue Medications vs Hours

Marketing

"One dose of Exparel provides up to 72 hours of postsurgical pain control with a decrease in opioid consumption without the need for catheters or pumps."

FDA Review

"Between 24 and 72 hours after study drug administration, there was minimal to no difference between EXPAREL and placebo treatments on mean pain intensity; however, there was an attendant decrease in opioid consumption, the clinical benefit of which was not demonstrated."

Safety

- No primary safety outcome defined
- Identified opioid-related adverse effects
Error Potential

- Inadvertent IV administration
- Institute for Safe Medication Practices (ISMP) issued warning

Bupivacaine liposome injectable suspension (Exparel™)

Recommend to add to formulary
- a. Yes
- b. NO

8 Unpublished Trials

- plain bupivacaine as active comparator

Decisions, Decisions... Debates in Therapeutics

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Mupirocin

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Disclosure Statement

• The speaker has no conflicts of interest or relationships with commercial entities that may be referenced in this presentation

Additional Goals

1. Recognize the recent rise in MRSA rates in hospital and community settings and its infectious impact on morbidity and mortality.
2. Describe how Staph aureus carriers increase their risk of infection once entering hospital settings.
3. Name the most common method of decolonization in the United States.
4. Recall the three uses of mupirocin for decolonization discussed in this presentation.
5. Indicate the most concerning consequence of wide spread mupirocin use.

Staph aureus colonization

• Common site is anterior nares
  – Carriers of Staph aureus in healthy adults (30%)
  – High rates of colonization in hospital inpatients, IVDU, insulin-dependent diabetics, HIV positive and hemodialysis patients
  – Extranasal colonization
    • Throat, perineum, GI tract, cutaneous sites
• Prerequisite to staphylococcal infections
  – Two to 12 times higher vs. non-colonizers
  – Bloodstream, dialysis-associated and surgical site infections

In the U.S., MRSA rates range from 50-60% for non-ICU and ICU settings
• More morbidity and mortality associated with MRSA versus MSSA infections
  – Mortality as high as 25% in some settings.

Boucher HW et al. CID 2009
Rybak M, AJHP 2009
Liu C, et al. CID 2011

Bad Bugs, No Drugs No ESKAPE! An Update from the Infectious Diseases Society of America

Therapeutic monitoring of vancomycin in adult patients: A consensus review of the American Society of Health System Pharmacists, the Infectious Diseases Society of America, and the Society of Infectious Diseases Pharmacists

Clinical Practice Guidelines by the Infectious Diseases Society of America for the Treatment of Methicillin-Resistant Staphylococcus Aureus Infections in Adults and Children
Decolonization Methods

- Anti-septic body wash therapy
  - Chlorhexidine, Hexachlorophene, Bleach, Other
- Topical and/or nasal therapy
  - Mupirocin, Bactracin, Other
- Oral antimicrobial therapy
  - Rifampin, TMP/SMX, Clindamycin, Minocycline

Mupirocin

- Formally known as pseudomonic acid A
  - Major metabolite derived from submerged fermentation by Pseudomonas fluorescens.
- Bacterial RNA and protein synthesis inhibitor
  - Inhibits bacterial isoleucyl-transfer RNA (tRNA) synthetase
- Bactericidal: topical administration after 24 to 36 hours of exposure
- Highly active (in vitro) against staphylococcal strains (including MRSA) and streptococci (except enterococci)
- Lacks (in vitro) activity against gram-negatives, anaerobes and fungi
  - Minimal activity against normal skin flora (Micrococcus, Corynebacterium and Propionibacterium spp.)

Use of Mupirocin for Decolonization

- Nasal Staphylococcal carriage prior to elective surgery
- Inpatient MRSA colonization - Infection control programs
- Recurrent skin and soft tissue infections - Community-associated MRSA

Evidence: Surgical Patients

- Kluytmans JA et al. 1996
  - Single-center, unblinded intervention trial
  - Perioperative decolonization with mupirocin nasal ointment reduces surgical-site infection rates (Staph aureus) in cardiothoracic surgery
  - ITT analysis: Significant reduction in SSI rate
    - 7.3% (control) vs 2.8% (intervention); P < 0.0001
  - Limitation: historical controls

- Van Rijen M et al. 2008
  - No effectiveness was observed among the non-carriers (RR 1.09, 95% CI 0.52-2.28)
Evidence: Surgical Patients

Bode L et al. NEJM 2010

Departments included: internal medicine, cardiothoracic surgery, vascular surgery, orthopedics, gastrointestinal surgery, or general surgery

Evidence: Inpatient ICU MRSA Colonization - Infection Control

**Evidence: Inpatient ICU MRSA Colonization - Infection Control**

- Forty-five US hospital currently participating in a cluster randomized trial
- Prevention of MRSA infection in ICUs
  1. Positive screening cultures of ICU admission → contact precaution
  2. Positive screening cultures of ICU admission → decolonization
  3. Universal decolonization of ICU admission without screening
- Prevention of MRSA infection in ICUs

**Evidence: Recurrent Skin and Soft Tissue Infections - Community-associated MRSA**

- Recurrent SSTI despite optimizing wound care/hygiene measures
- Ongoing transmission among household members or close contacts despite optimizing wound care/hygiene measures
- Decolonization strategies should be offered in conjunction with ongoing reinforcement of hygiene measures
  - Mupirocin twice daily for 5–10 days
  - Mupirocin twice daily for 5–10 days
  - With a skin antiseptic solution (eg, chlorhexidine) for 5–14 days or bleach baths

**Mupirocin for Decolonization**

- Clinical and epidemiological outcomes influencing use
  - Perioperative eradication of S. aureus colonization
  - Controlling for HA-MRSA and transmission
  - Incidence of CA-MRSA
- Learning from others
  - UK - screening includes all hospital admissions
  - Utilizing much more mupirocin
  - UK - high-level mupirocin resistance ~ 12%
    - MIC > 512 mg/mL
      - Independently associated with decolonization failure
      - Selection of increased drug resistance in S. aureus
    - Plasma carrying resistance determinants to other antimicrobial agents, including macrolides, gentamicin, tetracycline, and trimethoprim

**Mupirocin Resistance in the US**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Screening</th>
<th>Detection</th>
<th>Patient Contact</th>
<th>Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug</td>
<td>MIC &lt;= 4 mg/mL</td>
<td>MIC &gt; 4 mg/mL</td>
<td>MIC &gt; 512 mg/mL</td>
<td>MIC &gt; 512 mg/mL</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>512</td>
<td>1,280</td>
<td>32,000</td>
<td></td>
</tr>
<tr>
<td>Tobramycin</td>
<td>128</td>
<td>256</td>
<td>5,120</td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Mupirocin</td>
<td>128</td>
<td>256</td>
<td>5,120</td>
<td></td>
</tr>
</tbody>
</table>

**References**

Post Test Question 1
Which of the following resistant gram-positive organism has been on the rise in hospital and community settings resulting in mortality as high as 25%?
A. Methicillin-sensitive Staph aureus
B. Methicillin-resistant Staph aureus
C. Vancomycin resistant enterococci
D. Multidrug resistant Streptococcus pneumonia

Post Test Question 2
Risk of infection increases when asymptomatic carriers of Staph aureus enter this setting:
A. Hospitals
B. Nursing home
C. Rehabilitation centers
D. Retirement centers

Post Test Question 3
Which of the following methods of decolonization was found to be the most favorable among infectious diseases consultants?
A. Rifampin
B. Bleach
C. Chlorhexidine with Bacitracin
D. Mupirocin with or without Chlorhexidine

Post Test Question 4
Compelling evidence to support the use of mupirocin as a decontamination agent is largely available for:
A. Nasal Staphylococcal carriage prior to elective surgery
B. Inpatient MRSA colonization – Infection control programs
C. Recurrent skin and soft tissue infections – Community-associated MRSA
D. Elderly long-term care facility residents colonized with Staph aureus

Post Test Question 5
Widespread use of mupirocin will likely increase the risk of:
A. Cost
B. Allergic reactions
C. Resistance
D. Tolerance