Use and abuse of antibiotics

By Steven G. Morrow, USA

For the past 90 years, anti-
biotic therapy has played a
major role in the treatment
of bacterial infectious diseases.
Since the discovery of penicillin in 1928 by Bem-
ning and Chain in 1943 by Domagk, the entire world
has benefited from the development of these medi-
ments in Europe, North America,
and the quality of life for mil-
ions of people.

According to the Centers for Disease Control and Preven-
tion, life expectancy of individu-
als in the United States born in
1900 was 47 years, while those
born in 2005 are expected to live
78 years.1 At the beginning of the
20th century, the infant (< 1 year) mortality rate in the
United States was 100/1000 live births compared to 6.7/1000
in 2005.2 The major reason for
these improvements is that infec-
tions and, as such, the emergence of more resistant
organisms. Antimicrobial
resistant microorganisms. Antimicro-
bial resistance is a significant contrib-
uting factor in the selection of the most sophisticated hospi-
tals in Europe, North America
and Asia, there is virtually no sign of this “killer superbug” in
Norway. The reason? Norway
stopped using so many antibiot-
ics.

We don’t throw antibiotics at
every person with a fever. We
tell them to hang on, wait and
see, and we give them a Tyle-
tol to feel better,” said Dr. John
Haug, infectious disease spe-
nialist to feel better,” said Dr. John
Haug, infectious disease spe-
Pennsylvania.7 The authors
state in a recent article, the re-
view concluded that in-
to antibiotic resistance
in bacteria of the oral flora.5 The review concluded that in-
appropriate antibacterial drug
prescribing by dental practice-
staff and other hospitalized patients. These drug-resistant
infections may subsequently
be transmitted to other patients.6

The British Society for Anti-
imicrobial Chemotherapy pub-
lished a review in the Journal of Antimicrobial Chemotherapy.
This review examined the con-
tribution of antibacterial prescribing by general dentists in the
United Kingdom has made to the se-
lection of antibacterial resistance in bacteria of the oral flora.5 The review concluded that in-
appropriate antibacterial drug
prescribing by dental practice-
staff and other hospitalized patients. These drug-resistant
infections may subsequently
be transmitted to other patients.6

The British Society for Anti-
imicrobial Chemotherapy pub-
lished a review in the Journal of Antimicrobial Chemotherapy.
This review examined the con-
tribution of antibacterial prescribing by general dentists in the
United Kingdom has made to the se-
lection of antibacterial resistance in bacteria of the oral flora.5 The review concluded that in-
appropriate antibacterial drug
prescribing by dental practice-
staff and other hospitalized patients. These drug-resistant
infections may subsequently
be transmitted to other patients.6

The council’s position statement
further identified that “Antibiot-
ics are properly employed only
for the management of active infectious disease or the pre-
vention of metastatic infection,
such as infective endocarditis,
in medically high-risk pa-
tients.”7

One method of education is to
teach from errors rather than
principles. Psychologists from
the University of Exeter have
identified that “Antibiotics are properly employed only
for the management of active infectious disease or the pre-
vention of metastatic infection,
such as infective endocarditis,
in medically high-risk pa-
tients.”7

Myth No. 5: The most impor-
tant decision which antibiotic to use. To avoid the deleterious
effects of needless antibiotics on the patients and
the environment, the most important initial
decision is not which antibiotic to prescribe but whether to use
one at all. It has been estimated that up to 60 percent of human
infections resolve by host de-
defenses alone following removal of the source of the infection
(extraction, endo-

cic therapy, when the cause is readily iden-
tifiable. Whenever antibiotic
therapy is used, the risk of bac-
tautical infections developing resistance.

Many worldwide strains of Staphylococcus aureus exhibit resistance to all medically im-
portant antibiotic drugs, including methicillin-resistant S. aureus has become one of the most
frequent nosocomial, or hospital-
acquired, pathogens. The rate
at which bacteria develop re-

ciprocal relationship with the host,
there is ample evidence to support
that opportunistic normal oral microbially colonize in a symbi-

Primary Reasons for Revision of Infective Endocarditis Guidelines

1. IE is much more likely to result from frequent exposure to random bacteremias associated with daily activities than from bacteremias caused by a dental, GI tract or GU tract procedure.

2. Prophylaxis may prevent an exceedingly small number of cases of IE, if any, in individuals who undergo a dental, GI tract or GU tract procedure.

3. The risk of antibiotic-associated adverse events exceeds the benefit, if any, from prophylactic antibiotic therapy.

4. Maintenance of optimal oral health and hygiene may reduce the incidence of bacteremia from daily activities and is more important than prophylactic antibiotics for a dental procedure to reduce the risk of IE.

Table 1. (TableProvided by American Association of Endodontists)

Fig. 1. Acute apical abscesses and sinus.

Fig. 2. Chronic apical abscess.

Fig. 3. Acute apical abscess with intranodal local-
ized swelling.

Use and abuse of antibiotics

mCME articles in Dental Tribune have been approved by:

ADA CERP as having educational content for 2 CME Credit Hours

DHA awarded this program for 2 CPD Credit Points

CAPmore designates this activity for 2 continuing education credits.
Medical Conditions for Which Endocarditis Prophylaxis is Recommended:

1. History of IE.
2. Prosthetic cardiac/heart valve.
3. History of IE.
4. Premedication is recommended ONLY for patients with the following conditions associated with the highest risk of adverse outcomes: 
   a. Individuals with kidney dialysis shunts
   b. Individuals with congenital heart disease
   c. History of IE.
5. Special situations and circumstances:
   a. Premedication is recommended ONLY for patients with the following conditions associated with the highest risk of adverse outcomes:
   b. Medical Conditions for Which Endocarditis Prophylaxis is Recommended:
   c. Prophylaxis may prevent an exceedingly small number of cases of IE, if any, in individuals who undergo a dental, GI tract or GU tract procedure.
   d. Use and Abuse of Antibiotics: Winter 2012
   e. Antibiotics that can penetrate the mammalian cell (erythromycin and metronidazole) are superior to a single antibiotic. When the purported benefits of antibi- otic combinations are weighed against the possible conse- quences to the host as well as to the microbial environment, this assumption is not always real- ity. The usual sequela to com-

Table 2 (Table Provided by: American Association of Endodontists)

<table>
<thead>
<tr>
<th>Use and Abuse of Antibiotics: Winter 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pen-V-K is the antibiotic of choice for endodontic infections due to its effectiveness in polymicrobial infections, its relative narrow spectrum of activity against bacteria most commonly found in endodontic infections, its low toxicity and low cost.</td>
</tr>
<tr>
<td>2. Clindamycin is the antibiotic of choice for patients allergic to penicillins.</td>
</tr>
<tr>
<td>3. While amoxicillin and augmentin (amoxicillin plus clavu- lanate) demonstrated a higher antibacterial effectiveness than Pen-V-K, due to the broader an- tibacterial spectrum of amoxi- cillin and the increased cost of augmentin, the authors rec-</td>
</tr>
<tr>
<td>4. Acute apical abscess with extraoral diffuse facial cellulitis.</td>
</tr>
</tbody>
</table>

The answers and critiques published herein have been checked carefully and represent authoritative opinions about the questions concerned. Articles are available on www.cappmea.com after the publication. For more information please contact events@cappmea.com or +971 4 3616174.
binned antibiotic therapy results in a greater selective pressure on the microbial population to develop resistance. The greater the antibiotic spectrum of the antimicrobials used, the greater the likelihood of developing drug-resistant microorganisms that develop, and the more difficult it is to treat a resulting super-infection. The primary clinical indication for combined antimicrobial therapy is a severe infection in which the offending organism(s) is unknown and no culture results may ensue if antibiotic therapy is not instituted immediately before culture and sensitivity tests are available.3

Myth No. 6: Bactericidal agents are always superior to bacteriostatic agents. Bactericidal agents are required for patients with impaired host defenses.3 However, bactericidal agents are usually satisfactory when the host’s defenses against infections are unimpaired. Postoperative suture removal and persistent suppression of bacterial growth after previous exposures are also more persistent and reliable with bactericidal agents (erythromycin or penicillin) than with bacterioidal agents (beta-lactamase amase) because the clinical effects of bacterioidal antibiotics are less dose-dependent.

Myth No. 7: Antibiotic dosages, dosing intervals and duration of therapy are established for most infections. After more than 80 years of antibiotic usage, the proper dosages, dosing intervals and duration of therapy are essentially unknown for most specific infections.4 Infectious diseases are associated with a high number of variables that affect treatment outcome (microbial characteristics and drug sensitivity, diverse resistance mechanisms, tissue barriers to antibiotic diffusion, and the integrity and activity of the host’s defense mechanisms). However, basic principles are available to guide the dental health care provider in establishing proper dosages, dosing intervals and duration of therapy once the microbial pathogen(s) is/are identified and a rational choice of antimicrobial agent is made. The following principles of an- tibiotic dosing are adapted from Dr. Thomas J. Pallerla.1 The current recommendation is to employ an antimicrobial on the basis of antibiotics, dosing regimens and treatment duration for as short a period of time as the clinical situation permits. The major factor in the clinical success of most antimicrobials is the height of the serum concentration of the drug and the resulting amount in the infected tissue(s). Also important to the host is the ratio of the antimicrobial agent for as short a duration of therapy as possible to the infecting proportion of the infected tissue.5,6 Administration of antibiotics that exceed the minimal inhibitory concentration for a drug is usually achieved in a time such as five to three times the drug’s half-life. Amoxicillin has a half-life of one to one-and-a-half hours. A steady-state blood level would then be achieved in three to seven-and-a-half hours, thereby leading to a substantial serum antimicrobial level.7,8 The relative merits of continuous therapeutic antibiotic blood levels. A loading dose of two times the main- tenance dose is recommended for acute oral infections, which better achieves the goal of rapid, high blood levels rather than initiating therapy with the maintenance dose. Prolonged therapy should ideally be administered at dosing intervals of three to four times its six-hour dosing intervals. For example, the serum half-life of Pen-V-K is 0.75 hours. Higher continuous blood levels of this antibiotic are more likely to be obtained with four-hour rather than six-hour dosing intervals. The shorter the serum half-life of the drug, the shorter the dosing interval will need to be in order to maintain continuous therapeutic levels of the blood. When determining the appropriate dosing interval, it is also important to consider the following: 1) the postantibiotic effects of the drug; and 2) the relative merits of continuous or pulse dosing. PAEs are more persistent (two to seven hours) with antibiotics that act intracellularly within the microbial cytoplasm (erythromycin, clina- daicyn and tetracycline) or by suppression of nuclear acid syn- thesis (metronidazole, quinolones). As a result, these antibiotics are more effective with pulse dosing (high antibiotic blood levels at widely spaced intervals). The beta-lactam antibiotics, however, or have a slow, time-dependent killing activity and demonstrate very little PAE. Beta-lactam microbial killing requires mi- crobial growth after previous exposure. Therefore, beta-lactam antibiotics are always superior to bacteriostatic agents for the treatment of invasive infections (normal = 4,000-11,000). It is not currently recommended that patients with AIDS receive beta-lactam prophylaxis prior to dental treatment. The opportunistic pathogens com- monly encountered in the development of antibiotic-resistant microorganisms are usually too slowly proliferating to be routine prophylactic antibiotics and such a practice may result in resistance to routine prophylactic antibiotics and such a practice may result in the development of antibiotic-resistant microorganisms, thereby resulting in a serious super-infection.9

Antibiotic prophylaxis for prevention of infective endo- carditis The American Heart Association’s recommendations for the prevention of IE in medically-at-risk patients for more than 50 years. The most recent guidelines, published in April 2007, represent a signifi- cant change from the previous guidelines.10 One of the stated indications for the development of an updated guideline was the risk of antibiotic-associated adverse events experienced by patients who received prophylactic therapy (Table 1). It is well accepted that the risk of antibiotic-associated adverse events is low. The majority of published studies regarding IE being caused by oral bacteria have focused on dental procedures. Although the infective dose required to cause IE in humans is un- known, the number of microorganisms present in the blood following a dental procedure is low. It has long been assumed that dental procedures may cause bacterial colonization and reduce subsequent postoperative or post- treatment complications. The only established use of antibiotic prophylaxis in dentistry is in the attempt to reduce the potential consequences of bacteremia as induced by dental treatment in patients who also have specific medical conditions. Controversial indications include patients with orthopedic prosthetic devices, indwelling catheters, and impaired (immuno- suppressed) host defenses.
of adverse outcomes from IE and who would derive the greatest benefit from prevention. In addition, the dental office is a common setting for such dental procedures that are reasonable, even though we acknowledge that its effectiveness is unknown.19

Therefore, the 2007 AHA guidelines indicate that antibiotic prophylaxis should be considered for patients presenting for dental procedures who have cardiac conditions associated with the highest risk of adverse outcomes from IE. However, the evidence for some dental procedures is reasonable, even though we acknowledge that its effectiveness is unknown.19

In this case, the dentist is entirely guided by the current guidelines. A recommendation from his or her professional organization is the starting point for making treatment decisions for a patient with prosthetic joint disease. The dentist is ultimately responsible for the final decision, taking into account his or her patient based on the dentist’s professional judgment.

In February 2006, the AAOS published an information statement in which it recommends that “clinicians consider antibiotic prophylaxis in all patients with prosthetic joints.”18 A 2003 advisory statement included some modifications of the clas
cification of patients at potential risk and the stratification of bacteria associated with prophylaxis (Table 5), but it does not include routine local anesthetic injections through noninfected tissue (Table 5).

While bacteremias can cause hematogenous seeding of total joint implants, it is likely that more oral bacteremias are spontaneously induced by routine daily dental procedures. Patients who have undergone total joint arthroplasty should be encour-
aged to perform effective daily oral hygiene procedures in order to maintain good oral health.20 The rate of bacteremias is much higher in a mouth with good oral health. The risk of bacteremia is the opinion of the work group during dental treatment without anti-

iclcation in a small number of pa-

pers. However, it is advised to consider antibiotic premedication in a patient with prosthetic joint disease who is at potential infection risk. Bacteremias can occur as a result of experiencing hematogenous total joint infection (Table 5).

The authors of the AAMS position statement reviewed the available literature on the subject as it relates to the AAOS 2000 guidelines and concluded: “The risk of patients experiencing drug reactions is negligible compared to the risk of bacterial infections and the cost of antibiotic medications alone do not justify the practice of antibiotic prophylaxis in (all) patients with prosthetic joints.” The authors called for future multidisciplinary, systematic review of the literature relating to antibiotic prophylaxis in patients with prosthetic joints.

In the meantime, they concluded that the new AAOS 2009 information statement should not replace the 2005 joint consensus statement.21

In December 2012, a panel of experts representing the Amer-

1. The practitioner might con-
sider discontinuing the practice of routinely prescribing prophylactic antibiotics for patients with hip and knee prosthetic joint implants undergoing dental procedures. “We are unable to recommend for or against the use of topical oral antiseptics and mouthwash with or without antibiotic prophylaxis in other orthopedic implants undergoing the procedure.

2. We are unable to recommend for or against the use of topical oral antiseptics and mouthwash with or without antibiotic prophylaxis in other orthopedic implants undergoing dental procedures.

3. References

About the Author

Having taught oral healthcare professionals at Loma Linda University School of Dentistry since 1965, Steven M. Monaco, DMD, MS, has served as a professor in the department of endodontics that he chaired from 1987 to 1990.

He maintains responsibilities accepted in 2008 as direc-
tor of patient care services and clinical quality assurance. He was director, District VI, of the American Association of Endodontists from 1991 to 1997. He has also served as president of the Southern California Acad-
emy of Endodontics and as presi-
dent of the California State Board of Dentists.

In 1987, he earned diplomate sta-

des from the American Board of Dentistry. Since 1998, he has been a fellow of the American College of Dentists; and since 1998, he has been a fellow of the American Academy of Oral Medicine. He has served as an expert consultant for the American Dental Association, American Academy of Endodontists and the California State Association of Endodontists. He has also served as the secretary for the second term as a member of the Dental Board of California.