

MEDICAL CONDITIONS , MEDICATIONS AND GERODONTOLOGY

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**ABSTRACT:** An increasing percentage of the population is now living longer. The elderly are more likely to have medical conditions which can affect their systemic well-being, their oral health and their ability to undergo dental treatment. This can be compounded by polypharmacy .There are significant physiological changes that occur in old age. These can affect an individual's ability to process drugs. The General Dental practitioner need to be familiar with the potential influences of systemic diseases and also with the potential for side-effects and interactions associated with a wide range of medications and impact of ageing on pharmacokinetics and pharmacodynamics of any drug taken. The aim of this article is to outline the `must know` facts about most common medical conditions affecting elderly and medications used to treat systemic diseases that impact upon the oral mucosa and principles that should be borne in mind when prescribing medication for this group.

**KEYWORDS:** Systemic Diseases,Pharmacokinetics,Elderly, Gerodontology, Medications

INTRODUCTION

Worldwide population demographics are changing rapidly . Approximately 60 crore people are currently aged 60 years and over, and this number is expected to double by 2o25<sup>1</sup>.It is evident even in India. Gerodontology can be seen as a burden for the practitioner as there is a perception that this population group is in deteriorating systemic and oral health. However ,in reality working with older patients will provide a stimulating and challenging opportunity for the profession. These patients require a cautious approach as a result of the pathological and physiological alterations that occur during ageing. Accurate and detailed medical and drug histories are important in dental practice as many conditions and medications can influence oral health and dental care in patients. The General Dental Practitioner will increasingly be faced with elderly patients requiring the administration of a variety of drugs.These changes may influence the patient's ability to process drugs and can affect the adverse reactions that may occur. The General Dental practitioner needs to be familiar with the guiding principles to increase the safety, when prescribing medication for this group.

Common Medical Conditions Affecting Elderly

Within an ageing population specific disease patterns are emerging, with older people more likely to develop several chronic diseases. <sup>2,3</sup> The most common conditions affecting elderly ambulatory patients are arthritis, cancer, chronic obstructive pulmonary disease, diabetes, cardiovascular disease, mental health conditions, osteoporosis, Parkinson's disease and stroke<sup>4</sup>.

The relevance of these systemic conditions to dental practitioners is two-fold. First the conditions themselves can impact upon dental treatment or can have oral manifestations. Secondly, many of the pharmacological interventions prescribed for chronic conditions can have multiple and diverse adverse effects on the oral environment. The medications used in some of these conditions and their oral side- effects are represented in Table I . Many of these medications have significant side-effects on various body organs and tissues.

Table.1 Medications and their oral side effects	
Category of drug	Oral side-effects
1 Arthritis	
Corticosteroids	Oral microbial infections Poor wound healing
Methotrexate	Oral ulceration
NSAIDs	Haemorrhage Lichenoid mucosal reaction
2. Chronic obstructive pulmonary disease	
Corticosteroids	Oral microbial infections Poor wound healing
3. Diabetes	
Oral hypoglycemic	Lichenoid mucosal reaction Taste disturbance
4. Cardiovascular Disease	
ACE Inhibitors	Lichenoid mucosal reaction Oral ulceration , Taste disturbance.
Alpha Blockers	Lichenoid mucosal reaction Salivary dysfunction. Hemorrhage
Anti Coagulants	Lichenoid mucosal reaction, Oral ulceration
Beta Blockers	Salivary dysfunction
Calcium Channel blockers	Gingival enlargement, Lichenoid mucosal reaction ,Salivary dysfunction
Diuretics	Taste disturbance . Lichenoid mucosal reaction
Potassium channel activators	Salivary dysfunction, Taste disturbance.
Statins	Oral ulceration Lichenoid mucosal reaction
5. Parkinson's disease	
Levodopa	Salivary dysfunction Taste disturbance

Arthritis

Osteoarthritis (OA) affects the weight-bearing joints resulting in the degeneration of articular cartilage and subchondral bone. Over 80% of people 75 years or older have clinical signs of OA and more than 80% of people over 50 years of age have radiographic evidence of OA<sup>6</sup>. It can result in pain and limitation of movement, particularly after a period of rest. Management of the condition is aimed at symptomatic relief with non-steroidal anti-inflammatory agents and physiotherapy to help with the stiffness. With disease progression joint replacement of hips or knees may be necessary.

Rheumatoid arthritis (RA) is an inflammatory disease affecting peri-articular tissue and bone. RA affects approximately 1 % of the population and is more common in females than in males.<sup>7</sup> It classically manifests as symmetrical polyarthritis and can have multiple extra-articular features. Management of this condition can include analgesics, corticosteroids and immunomodulatory agents.<sup>8</sup>

Neither condition commonly has oral manifestations, however, arthritic changes can occur in the temporo - mandibular joint. During dental visits, patients with RA should not be maintained in the supine position owing to the risk of dislocation of the atlanto-axial joint in the neck.

Cancer

Genito-urinary, gastro-intestinal and lung cancers are the most common malignancies affecting the elderly.<sup>9</sup> Although these conditions do not have a direct effect on the oral cavity, the treatment involved in the management of these malignancies may impact upon the mouth. Some chemotherapeutic agents can cause oral mucositis and intravenous bisphosphonates, used in the treatment of prostate, bone and breast cancer and multiple myeloma, are associated with bisphosphonate-related osteonecrosis of the jaws (BRONJ) .

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is a term used to represent a number of conditions that result in progressive pulmonary airflow limitation. COPD is a leading cause of morbidity and is projected to rank fifth in 2020 as a worldwide burden of disease.<sup>10</sup> These conditions include bronchitis, emphysema and chronic asthma.

Although there are no oral manifestations of these diseases, care needs to be taken in the treatment of patients with these conditions. Patients with COPD should be treated in the upright position as they can become breathless when supine. Patients should be advised to bring inhalers with them to their appointments. The use of corticosteroid inhalers can lead to oral fungal infections, therefore patients should be encouraged to rinse their mouth after use.

Diabetes

Diabetes mellitus (DM) affects over 171 million people worldwide.<sup>11</sup> Type II DM is more common in all age groups and can be related to lifestyle, whereas Type I is more common in younger people but can present at any age. Development of the condition in the elderly can present unusually in the form of complications associated with DM, such as cataract or peripheral vascular disease.

The principal risk to the diabetic patient during dental treatment is hypoglycemia . This risk can be reduced by advising the patient to maintain regular meals and insulin

times on the day of the dental appointment and to arrange the appointment time around these events. Diabetic patients are predisposed to oral candidal infections and poorly controlled diabetics can be immunocompromised. Peripheral neuropathies, a complication of DM, can present in the oropharyngeal region leading to deficits in taste and smell and a burning sensation in the mouth.<sup>12</sup> The most pronounced oral change seen in patients with diabetes is more aggressive periodontal disease.<sup>13</sup>

### Cardiovascular disease

Cardiovascular disease increases exponentially between ages 40 and 80.<sup>14</sup> Hypertension, one of the most adjustable risk factors for cardiovascular disease, can be difficult to diagnose in the elderly as blood pressure naturally rises with age. Ischaemic heart disease is a disease of the coronary arteries due to atheroma and is responsible for 70% of all deaths after the age of 75 years.<sup>15</sup> Clinically, the conditions associated with ischaemic heart disease are angina pectoris, myocardial infarction and sudden death. With regard to the oral manifestations of these conditions, patients with angina and myocardial infarction can experience referred pain to the head and neck, including the mandible.

### Mental health conditions

The likelihood of developing mental health conditions such as dementia, the progressive and irreversible impairment of cognitive function, increases with age.<sup>16</sup> Dementia affects up to 9.4% of those over the age of 65 years<sup>17</sup> and approximately 20% over the age of 80. there are no specific oral manifestations, however, owing to the impaired cognitive function, patients are frequently unable to maintain oral hygiene.<sup>18</sup> This results in increased susceptibility to dental disease.

### Osteoporosis

Osteoporosis is a condition in which there is a loss of bone mass. It is inversely linked to oestrogen levels and therefore is more prevalent in post menopausal women. It is estimated that over 200 million people worldwide have osteoporosis.<sup>19</sup> Although the oral manifestations of osteoporosis are now rare, it can affect the mandible and the maxilla, leading to increased risk of fracture with extraction. In addition to the possibility of oral involvement in this condition, the prolonged use of corticosteroids in the management of some oral mucosal conditions can also lead to the complication of osteoporosis. Oral bisphosphonates are used in the management of osteoporosis.<sup>20,21</sup> The importance of maintaining optimal oral health, and the need to attend their dental practitioner if oral symptoms develop are critical.

### Parkinson's disease

Parkinson's disease is a condition caused by denervation of the dopaminergic pigmented neurones in

the basal ganglia, with a variable prevalence of up to 1.5% in people over the age of 60 years reported in Europe.<sup>22</sup> It is characterized by a trio of signs - tremor, bradykinesia and rigidity. An early sign of the condition can be hypersalivation<sup>23</sup> leading to drooling of saliva and progression of the disease can lead to dysphagia in up to 80% of patients.<sup>24</sup> In the later stages of the condition the excess saliva, difficulty swallowing and the flexed neck position associated with the rigidity can result in difficulty with dental treatment. Dopaminergic agonists are commonly used as early monotherapy and also used as an adjunct to Levodopa in the management of Parkinson's disease.<sup>25</sup>

### Stroke

Stroke is characterized by the acute onset of neurological dysfunction with symptoms that persist after 24 hours. Approximately 150,000 people have a stroke annually in the UK and it is more common over 65 years. The resultant hemiparesis can lead to limited mobility and communication difficulties<sup>26</sup>. The oral consequences of these cerebrovascular accidents are long lasting oral sensory and motor deficits, resulting in loss of the gag reflex, poor tongue function and lip seal, difficulty eating and drinking, inability to maintain dental hygiene and impaired use of dentures.<sup>27</sup> No elective dental treatment should be carried out in the three months following a cerebrovascular accident and dentists may recommend the use of an electric toothbrush to compensate for limited dexterity in some cases.

Following a stroke, patients receive anti-coagulant therapy to prevent further cerebrovascular accidents. Warfarin is the most common anti-coagulant used as part of this preventive regime. Careful monitoring of the INR is required before dental treatment is carried out, with the current recommendation of an INR less than 4.0 for minor dental procedures, including extractions. Caution is also needed when prescribing any medications for these patients as numerous potential drug interactions can occur with Warfarin, resulting in either potentiation or inhibition of the drug.

### Physiological Changes In The Elderly

There are significant physiological changes that occur in old age. These can affect both the pharmacokinetics and pharmacodynamics of any drug taken. A description of the pharmacodynamic and pharmacokinetic changes that occur in the elderly will illustrate those principles that should be borne in mind when prescribing medication for this group in the population.

### Pharmacokinetics

Pharmacokinetics refers to the mechanisms by which a drug is absorbed, transported, distributed, metabolized and then excreted from the body. Changes

that occur with age can influence many of these processes and have a direct effect on the pharmacokinetics of drugs.

Absorption

Most drugs that dentists prescribe or administer are given orally or by injection. The gastro-intestinal system undergoes many changes throughout life, which can lead to a significantly altered absorption environment. Such changes include the reduced production of hydrochloric acid by the stomach,<sup>28</sup> decreased cardiac output with a parallel fall in gastro-intestinal blood flow, a reduction in gastro-intestinal emptying and lowered gastro-intestinal motility. Changes in the local vasculature will affect the absorption of drugs that are given by injection in older patients. Ageing effects on the lungs include reduced alveolar surface areas, potentially reducing the absorption of aerosols such as GTN spray or salbutamol.<sup>29</sup>

Distribution

Once a drug is absorbed into the body, it is transported via the circulation and is distributed throughout plasma, lean muscle mass or fat tissue. The compartment to which the drug is distributed is decided by the individual characteristics of the drug in question. Age-related changes to the body composition affect the proportions of these different tissues. Changes that occur during normal ageing include a decrease in total body water, a decrease in lean muscle mass and an increase in fat tissue.<sup>30,31</sup> This increases the risk of adverse drug reactions and problems with overdose. It is recommended that clinicians should reduce the dose of hydrophilic drugs include warfarin, propranolol and a number of hypnotics and sedatives.<sup>28,30</sup> and lipophilic drugs include midazolam and diazepam, lidocaine and some synthetic steroids ,administered to the elderly patient to compensate for this decreased volume of distribution.

Hepatic metabolism

The liver normally metabolizes drugs in a bi-phasic manner. Phase 1 reactions typically consist of oxidations, reductions and hydrolysis. Phase 2 processes consist of conjugation reactions. Hepatic blood flow parallels the decrease in cardiac output that occurs with age. This is responsible for the reduced liver clearance of some drugs.<sup>32</sup> Another factor that influences the hepatic metabolism of drugs is the decrease in liver enzymes responsible for drug metabolism.

Renal clearance

The ageing kidney undergoes changes in function, size and anatomy. In addition, there is a reduction in renal perfusion. These alterations combine to cause an overall reduction of between 35-50% in renal function in patients over the age of 65 years.<sup>31</sup>When prescribing a drug for the elderly dental patient, it is prudent to start with a low dose

and slowly increase it in a step-wise manner to avoid physiological, or renal, toxicity caused by a decrease in kidney function and a toxic increase in metabolites. This is particularly the case for drugs that are eliminated by the kidney. Such medicines include penicillins and aminoglycosides.<sup>33</sup> **Table.II** summarizes the pharmacokinetic changes that occur in the older patient.

Table.2. The effect of ageing on pharmacokinetics	
Mechanism of Pharmacokinetics	Alterations in the Elderly
Absorption	<ul style="list-style-type: none"><li>• Reduced hydrochloric acid in stomach</li><li>• Reduction in gastrointestinal blood flow</li><li>• Decreased gastric motility and emptying</li><li>• Reduced lung alveolar surface area</li></ul>
Distribution	<ul style="list-style-type: none"><li>• Reduced cardiac output</li><li>• Decreased total body water leading to increased concentration of hydrophilic drugs</li><li>• Decrease in lean muscle mass further reducing volume of distribution for hydrophilic drugs</li><li>• Increase in adipose tissue increasing distribution and half life of lipophilic drugs</li><li>• Decrease in albumin plasma concentrations leading to increased free-plasma concentrations of drugs</li></ul>
Hepatic metabolism	<ul style="list-style-type: none"><li>• Reduction in hepatic blood flow</li><li>• Reduction in hepatic enzymes affecting phase 1 metabolism</li></ul>
Renal clearance	<ul style="list-style-type: none"><li>• Reduction in renal blood flow</li><li>• 35-50% reduction in renal function</li></ul>

Pharmacodynamics

Pharmacodynamics is the mechanism by which a drug achieves its actions. The size of the response to any drug is affected by the concentration of the drug in question and the affinity of this drug for the relevant receptors. In other words, it is determined by the number of drug-receptor complexes that are achieved. Whilst most studies tend to be carried out in younger patients, there is

evidence that pharmacodynamic reactions can change with increasing age. These commonly result in an increased sensitivity to an administered drug, which may result from either a rise in the number of the drug receptors, or an increased receptor response following activation.

Adverse drug reactions (ADRs)

It is estimated that between 40-60% of patients who use NSAIDs are over the age of 60 years old.<sup>34</sup> The chances of unwanted effects arising from drugs are increased approximately 10-fold in the elderly patient. In fact, about 40% of all adverse drug reactions occur in older people.<sup>35</sup> The elderly population are heavy consumers of drugs. They receive some 40% of all drugs supplied.<sup>36</sup> In addition, the physiological changes that affect the pharmacodynamics in the elderly can lead to many of the common ADRs. Often, polypharmacy can lead to ADRs through prescription from multiple health providers with little or no knowledge of current drug history or poor clinician understanding of drug interactions. In addition, confusion of the patient may lead to misunderstandings over drug regimens or misidentification of the prescribed drugs. It is important that as simple a regimen as possible is followed when prescribing medication to older patients. Very clear instructions about dosing should be provided. This can be complicated by over-the-counter drugs that the patient may be taking.

Expected drug side-effects often occur in increased severity and incidence in elderly patients. Sometimes ADRs occur that are unexpected, or unpredictable, and the dental practitioner should remain alert to the potential for such reactions. The risk factors for ADRs are listed in **Table III.**

Table.3 Risk factors for adverse drug reactions
<ul style="list-style-type: none"><li>• Patients over the age of 85 years</li><li>• Female gender</li><li>• Low body weight</li><li>• Renal impairment</li><li>• Dementia</li><li>• Use of multiple prescribing healthcare workers/pharmacies</li><li>• Use of six or more medications</li></ul>

Summary of geriatric administration of commonly used drugs in dentistry

Local anaesthetics

Local anaesthetics are very safe drugs as long as they are injected into the correct site and appropriate doses are used. Factors that may affect the blood concentration of local anaesthetics in the elderly include systemic illness, age, body weight, drug composition and

dosage. Good clinical technique, with routine use of aspirating syringes and careful administration, can reduce the likelihood of depositing local anaesthetics directly into the bloodstream. Changes in liver and kidney function can affect both the blood concentration and the clearance of local anaesthetic solutions. The effect of these natural changes can be compounded when a systemic illness, such as liver disease, is present. When considering the total dosage that can be administered to an elderly patient, systemic illness should be taken into consideration.

It may be prudent to modify the safe doses for the elderly patient (for example, a maximum of 2.2 mg/kg for those over 65 instead of 4.4 mg/kg for lidocaine). Fortunately, dental local anaesthesia can be more effective in older compared to younger patients. This is probably the result of a reduced blood supply impairing absorption of the drug and decreased bone density allowing better infiltration.

Analgesics

The problems with administering long-term pain relief in the form of NSAIDs in elderly patients can be significant and can include peptic ulceration, confusion, renal impairment and, less rarely, hepatotoxicity. The use of NSAIDs in the elderly patient should therefore proceed with caution and the potential for ADRs must be balanced against the clinical benefit achievable.

Paracetamol should be considered the analgesic of choice in the elderly patient owing to its relative lack of side-effects and adverse reactions. of paracetamol. It may be advisable to avoid longer term, high dose paracetamol therapy, however, to minimize the risk of liver toxicity, especially in those patients with chronic liver disease. Dose adjustment are recommended for long term therapy as the metabolic and renal clearance of paracetamol are altered in elderly.

Antibiotics

Dose adjustment is not often required for the commonly prescribed antibiotics owing to their relatively short half life. The reduction in renal function means that caution should be exercised where an antibiotic is eliminated via the kidney. Penicillin has been shown to have a half life increase from 23.7 hours to 55.5 hours between the ages of 50 and 70 years. When the creatinine clearance falls below 30ml/min, the dose of renally cleared drugs should be halved. Therefore, in the presence of renal failure, penicillins, cephalosporins and tetracyclines should be reduced in dose, whilst routine dose reduction in antibiotic therapy lasting 1 -2 weeks has been shown to reduce the incidence of ADRs and nephrotoxicity.<sup>33</sup>

Generally, if the treating dentist has a concern about the renal function of an elderly patient, specialist advice should be sought before prescribing renally excreted drugs, including many commonly used antibiotics.

Practical points.

**Table.IV** outlines the points that should be considered when prescribing to an elderly patient. One of the reasons why drug therapy may fail is due to a lack of compliance. This is not always deliberate and may occur with older people for a number of reasons. If the patient is taking a number of medications at set times of the day it is worthwhile choosing the timing of doses for any new prescribed medication that fits in with the current schedule. This can be aided by the use of pill organizers.

Other problems that interfere with compliance include the inability to take the medication itself or take the appropriate dose. This can be the result of decreased manual ability with ageing or a concurrent condition such as Parkinson's disease. This can make it difficult to open child-proof containers. In any event, the taking of a good social history is important to ensure that help is available for proper drug administration.

The practical guidelines tha should be considered when prescribing to the elderly are listed in Table.IV..

Table. 4 Practical guidelines when prescribing to the elderly.
<p><b>Guidelines for Prescribing to the Elderly</b></p> <ul style="list-style-type: none"><li>• Take a thorough medical history</li><li>• Take an accurate drug history, including non-prescription drugs</li><li>• Take a thorough social history</li><li>• Take into account physiological effects of ageing, such as reduced renal function, kidney function, body composition</li><li>• For long-term drug treatment start dosing low and increase slowly</li><li>• Communicate with other healthcare workers to eliminate conflicting treatment or advice</li><li>• Simplify drug regimens - try to comply dose timings with other current therapies if possible - consider pill organizers</li><li>• Consider practical implications of drug storage containers and measurement of liquid volumes</li><li>• Refer to a publication such as the Formulary to check for possible drug interactions and the impact of renal and hepatic disease</li></ul>

CONCLUSION

General Dental practitioners need to be familiar with a variety of systemic and oral changes , those may be observed in elderly patients as a result of physiological and pathological process which have developed due to ageing and medications .Clinically, it is important to

recognize these aspects and to develop planning strategies which take account of them .

References:

1. World population Ageing: 1950-2050.United Nations Department of Economic and Social Affairs, 2002.
2. Bray F, Moller B. Predicting the future burden of cancer. *Nat Rev Cancer* 2006; 6:63-74. <http://dx.doi.org/10.1038/nrc1781>
3. Murray G, Lopez AD. Alternative projections of mortality and disability by cause 1990-2020: global burden of disease study, *Lancet* 1997; 349:1498-1504.[http://dx.doi.org/10.1016/S0140-6736\(96\)07492-2](http://dx.doi.org/10.1016/S0140-6736(96)07492-2)
4. Scully C, Ettinger RL. The influence of systemic diseases on oral health care in older adults. *J Am Dent Assoc* 2007; 138:7S-14S.
5. World Health Organization. *The Top Ten Causes of Death*. WHO fact sheet. Geneva: WHO, 2007.
6. Sharma L. Epidemiology of osteoarthritis. In: *Osteoarthritis: Diagnosis and Medical Surgical Management* 3rd edn. Moskovitz RW, Howell OS, Altman RD, Buckwater JA, Goldberg VM, eds. Philadelphia: Saunders, 2001: pp3-17.
7. Greenwood M, Meechan JG. General medicine and surgery for dental practitioners Part 8: musculoskeletal system. *Br Dent J* 2003; 195: 243-248. <http://dx.doi.org/10.1038/sj.bdj.4810470>
8. Scott D, Shipley M, Dawson A *etal*. The clinical management of rheumatoid arthritis and osteoarthritis: strategies for improving clinical effectiveness. *Br J Rheumatol* 1998; 37:546- 554. <http://dx.doi.org/10.1093/rheumatology/37.5.546>
9. Hansen J. Common cancers in the elderly. *Drugs Aging* 1998; 13:467-478. <http://dx.doi.org/10.2165/00002512-199813060-00005>
10. Murray CJL, Lopez AD. Evidence-based health policy - lessons from the Global Burden of Disease Study. *Science* 1996; 274:740-743. <http://dx.doi.org/10.1126/science.274.5288.740>
11. WHO Global Strategy on Diet, Physical Activity and Health - Diabetes, [www.who.int/diet\\_physical\\_activity/publications/fats/diabetes/en/](http://www.who.int/diet_physical_activity/publications/fats/diabetes/en/)
12. Settle RG.The chemical senses in diabetes mellitus. In: *Smell and Taste in Health and Disease*. Getchell TV, Doty RL, Bartoshuk LM, Snow JB Jr eds. New York: Raven Press, 1992: pp829-843.
13. Javed F, Nasstrom K, Benchimol D, Altamash M, Klinge B, Engstrom PE. Comparison of periodontal and socioeconomic status between subjects with type 2 diabetes mellitus and non-diabetic controls. *J Periodontal* 2007; 37. 78:2112-2119. <http://dx.doi.org/10.1902/jop.2007.070186>
14. Driver JA, Djousse L, Logroscino G, Gaziano JM, Kurth T. Incidence of cardiovascular disease and cancer in advanced age: prospective cohort study. *Br Med J* 2008; 337: a2467. <http://dx.doi.org/10.1136/bmj.a2467>

15. Hupp JR. Ischaemic heart disease: dental management considerations. *Dent Clin North Am* 2006; 50:483-491. <http://dx.doi.org/10.1016/j.cden.2006.06.002>
16. Ritchie K, Lovestone S. The dementias. *Lancet* 2002;360:1759-1766. [http://dx.doi.org/10.1016/S0140-6736\(02\)11667-9](http://dx.doi.org/10.1016/S0140-6736(02)11667-9)
17. Berr C, Wancata J, Ritchie K. Prevalence of dementia in the elderly in Europe. *Eur Neuropsychopharmacol* 2005; 15:463-471. <http://dx.doi.org/10.1016/j.euroneuro.2005.04.003>
18. Fiske J, Frenkel H, Griffiths J, Jones V. Guidelines for the development of local standards of oral health care for people with dementia. *Gerodontology* 2006; 23 (Suppl 1): 5-32.
19. Cooper C. Epidemiology of osteoporosis. *Osteoporos Int* 1999; 9: S2-S8. <http://dx.doi.org/10.1007/PL00004156>
20. Boivin GY, Chavassieux PM, Santora AC, Yates J, Meunier PJ. Alendronate increases bone strength by increasing the mean degree of mineralization of bone tissue in osteoporotic women. *Bone* 2000; 26:687-694. [http://dx.doi.org/10.1016/S8756-3282\(00\)00376-8](http://dx.doi.org/10.1016/S8756-3282(00)00376-8)
21. Raisz LG, Rodan GA. Pathogenesis of osteoporosis. *Endocrinol Metab Clin North Am* 2003;32:15-24. [http://dx.doi.org/10.1016/S0889-8529\(02\)00055-5](http://dx.doi.org/10.1016/S0889-8529(02)00055-5)
22. von Campenhausen S, Bornschein B, Wick R et al. Prevalence and incidence of Parkinson's disease in Europe. *Eur Neuropsychopharmacol* 2005;15:473-490. <http://dx.doi.org/10.1016/j.euroneuro.2005.04.007>
23. Chou K, Evatt M, Hinson V, Kompoliti K. Sialorrhea in Parkinson's disease: a review. *Mo Disord* 2007; 22:2306-2313. <http://dx.doi.org/10.1002/mds.21646>
24. Dougall A, Fiske J. Access to special care dentistry, Part 9. Special care dentistry services for older people. *Br Dent J* 2008; 205:421-434. <http://dx.doi.org/10.1038/sj.bdj.2008.891>
25. Antonini A, Tolosa E, Mizuno Y, Yanamoto M, Poewe WH. A reassessment of risks and benefits of dopamine agonists in Parkinson's disease. *Lancet Neurol* 2009; Aug 24 [Epub ahead of print].
26. Warlow C, Sudlow C, Dennis M, Wardlaw J, Sandercock P. Stroke. *Lancet* 2003; 362:1211-1224. [http://dx.doi.org/10.1016/S0140-6736\(03\)14544-8](http://dx.doi.org/10.1016/S0140-6736(03)14544-8)
27. Ostuni E. Stroke and the dental patient. *J Am Dent Assoc* 1994; 125:721-727.
28. Delafuente JC. Geriatric primers: pharmacokinetic and pharmacodynamic alterations in the geriatric patient. *Am Soc Consult Pharm* 2008; 23: 324-334. <http://dx.doi.org/10.4140/TCP.n.2008.324>
29. Allen S. Are inhaled systemic therapies a viable option for the treatment of the elderly patient? *Drugs Aging* 2008; 25: 89-94. <http://dx.doi.org/10.2165/00002512-200825020-00001>
30. Forbes GB, Reina JC. Adult lean body mass declines with age: some longitudinal observations. *Metabolism* 1970;19:653-663. [http://dx.doi.org/10.1016/0026-0495\(70\)90062-4](http://dx.doi.org/10.1016/0026-0495(70)90062-4)
31. Yeun GJ. Altered pharmacokinetics in the elderly. *Drugs* 1981; 22:279.
32. Wilkinsdh GR, Shand DG. Commentary: a physiological approach to hepatic drug clearance. *Clin Pharmacol Ther* 1975;18:377-390.
33. Pyle MA, Tolbert SR. Pharmacologic considerations in geriatric dentistry. *Dent Clin North Am* 1994; 38:755-767.
34. Gurwitz JH, Avorn J. The ambiguous relation between ageing and adverse drug reactions. *Ann Intern Med* 1991; 114:956-966
35. Guttman SP, Rodriguez G, Raiford DS. Individual nonsteroidal antiinflammatory drugs and other risk factors for upper gastrointestinal bleeding and perforation. *Epidemiology* 1997;8:18-24. <http://dx.doi.org/10.1097/00001648-199701000-00003>
36. Hobson M. Medications in older patients. *West J Med* 1992; 157: 539-543.

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