

GERINOTES

SECTION ON GERIATRICS, AMERICAN PHYSICAL THERAPY ASSOCIATION

President's Message: The Doorknob is Banned?

Editor's Message: Change is a Challenge

Health Reform and the Geriatrics Syndromes:
A Call for Interprofessional Practice

Adverse Drug Effects in the Elderly

CSM Programming 2014

Thyroid Dysfunction in Older Adults

Osteoporosis

Case Report for FM

Mayo Clinic Announces Physical Therapy
Geriatric Residency in Arizona

CEEAA – Congratulations Graduates

TABLE OF CONTENTS

President's Message: The Doorknob is Banned?3 <i>William H. Staples</i>	Osteoporosis 18 <i>Onkar J. Rajadhyaksha, Jennifer M. Bottomley</i>
Editor's Message: Change is a Challenge4 <i>Meri Goehring</i>	Case Report for FM 24 <i>Kenneth L. Miller, Matt Flynn</i>
Health Reform and the Geriatrics Syndromes: A Call for Interprofessional Practice5 <i>Kelly N. Poppaw, Michael J. Shoemaker</i>	Mayo Clinic Announces Physical Therapy Geriatric Residency in Arizona 26 <i>Kathryn Brewer</i>
Adverse Drug Effects in the Elderly8 <i>Melanie Hughes, Jennifer M. Bottomley</i>	CEEAA – Congratulations Graduates 27 <i>Danille Parker</i>
CSM Programming 201413	
Thyroid Dysfunction in Older Adults 14 <i>Debra L. Gray, Jennifer M. Bottomley</i>	

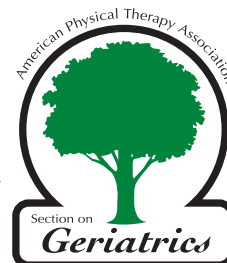
Publication Title: *GeriNotes*

Statement of Frequency: Bi-monthly; January, March, May, July, September, and November

Authorized Organization's Name and Address: Orthopaedic Section, APTA, Inc.
For Section on Geriatrics, 2920 East Avenue South, Suite 200, La Crosse, WI 54601-7202

Newsletter Deadlines: January 15, March 15, May 15, July 15, September 15, November 15

Editorial Statement: *GeriNotes* is not a peer-reviewed journal. Opinions expressed by the authors are their own and do not necessarily reflect the views of the Section on Geriatrics, APTA. The Editor reserves the right to edit manuscripts as necessary for publication. Copyright 2014 by the Section on Geriatrics, APTA.
All advertisements that appear in or accompany *GeriNotes* are accepted on the basis of conformation to ethical physical therapy standards, but acceptance does not imply endorsement by the Section on Geriatrics, APTA.



WANTED: ARTICLES FOR GERINOTES

TOPICS: Anything related to older adults

CLINICIANS: Send me an article or an idea

STUDENTS AT ANY LEVEL: Send me papers you wrote for class

EDUCATORS: Send me student papers

Everyone loves to publish and it is easy!

Contact Meri Goehring, GeriNotes Editor
goehrinm@gvsu.edu



PRESIDENT'S MESSAGE: THE DOORKNOB IS BANNED?

William H. Staples, PT, DHS, DPT, GCS, CEEAA



As I listened to my radio on the way into work, I heard that Vancouver, British Columbia, Canada had banned doorknobs. Say what? Yes, that everyday tool that has been in existence since people needed doors is now going the way of the rotary phone. So this is what is next? Remember the regular toilet? Try to find one. Low-flush, low water consumption is all there is to be had in the United States. Looking for an incandescent light bulb? Sorry, just energy-saving fluorescent or LED now in most stores. Is this an example of government control gone completely haywire? Thankfully no, Vancouver's ban on doorknobs for all new construction is based around the city's adoption of the concept of universal design. Door levers, not knobs will be required for all new buildings private and commercial. If you are not in step here, chances are the difference between the two probably seems cosmetic. But the concept behind Vancouver's ban is simple, and makes perfect sense because door levers are easier to open for older adults, people with injuries, or people with disabilities. According to the American Center for Independence of Individuals with Disabilities,¹ rounded doorknobs are a potential barrier of entry for people with disabilities or dexterity issues.

In addition, the same new law that banned knobs also introduced construction restrictions that forces new buildings to have lower light switches, wider hallways, and adaptable showers. These local restrictions are made possible because the Canadian city is the only one in the country with the ability to set its own building codes. And, as doorknobs go, so too will go those other ubiquitous

knobs, the ones that turn on and off water faucets. For they too are being legislatively upgraded to levers as well to be more conducive to the arthritic or weakened hands we earn with age or disease.

Universal design has begun to make its way to the mainstream. Universal design involves designing products and spaces so that they can be used by the widest range of people possible. Universal design is a process that addresses the needs of people with disabilities to allow access and function. The AARP² website lists many other universal design adaptations that many of us are already knowledgeable about, especially if you practice in the home health arena. For those of you are unfamiliar here is their list.

Essential Universal Design features include:

- No-step entry: At least one step-free entrance into your home either through the front, back, or garage door that lets everyone, even those who use a wheelchair, enter the home easily and safely.
- Single-floor living: Having a bedroom, kitchen, full bathroom with plenty of maneuvering room, and an entertainment area on the same floor makes life convenient for all families.
- Wide doorways and hallways: With your home's doorways at least 36 inches wide, you can easily move large pieces of furniture or appliances through your home. Similarly, hallways that are 42 inches wide and free of hazards or steps let everyone and everything move in, out, and around easily.
- Reachable controls and switches: Any one that even a person in a wheelchair can reach light switches that are from 42-48 inches above the floor, thermostats no higher than 48 inches off the floor, and electrical outlets 18-24 inches off the floor.
- Easy-to-use handles and switches: Lever-style door handles and faucets,

and rocker light switches, make opening doors, turning on water, and lighting a room easier for people of every age and ability.

There are many other universal design features and products that many people put into their homes, including:

- Raised front-loading clothes washers, dryers, and dishwashers
- Side-by-side refrigerators
- Easy-access kitchen storage (adjustable-height cupboards with lazy Susans)
- Low or no-threshold stall showers with built-in benches or seats
- Non-slip floors, bathtubs, and showers
- Raised, comfort-level toilets
- Multi-level kitchen countertops with open space underneath, so the cook can work while seated
- Windows that require minimal effort to open and close
- A covered entryway to protect you and your visitors from rain and snow
- Task lighting directed to specific surfaces or areas
- Easy-to-grasp D-shaped cabinet pulls

Vancouver has made some giant steps here. When will we follow suit?

REFERENCES

1. American Center for Independence of Individuals with Disabilities. <http://www.cidсанmateo.org/ada.html>. Accessed November 20, 2013.
2. American Association of Retired People. http://www.aarp.org/home-garden/home-improvement/info-09-2009/what_is_universal_design.html. Accessed November 20, 2013.

EDITOR'S MESSAGE: CHANGE IS A CHALLENGE

Meri Goehring, PT, PhD, GCS



Hello Geriatric Section Members and *GeriNotes* Readers,

As the new Editor for *GeriNotes*, I am pleased to introduce myself. First and foremost, I am a clinician. Although much of my time is now spent in academia, I am a clinician at heart. I continue to work as a clinician weekends and holidays and truly enjoy my work. So, as a busy academic, responsible for teaching, scholarship and service, how do I find time to serve as *GeriNotes* Editor? Well, I may put in some late nights. But, I hope to continue with the fine work of others. A big thanks goes to Melanie Sponholz, previous Editor. She has done a wonderful job assisting me in the transition. Also, thanks to the Geriatric Section Board and the *GeriNotes* Editorial Board for providing me with assistance and guidance in this task.

Now, let me share my vision for *GeriNotes*. I would like to continue to offer the opportunity to write about practice issues important to our members. I would like to continue to promote student publications and want to contact academic institutions and attempt to demonstrate how *GeriNotes* might be one avenue for students to actually see their work published. This particular issue has several student articles and I thank these students as well as their faculty mentor, Jennifer Bottomley. Interestingly, this issue also has an article from a former student at Grand Valley State University mentored by faculty member, Michael Shoemaker regarding the importance of interprofessional practice. One of the other articles was written by an Occupational Therapist. Articles regarding the values and challenges of interprofessional practice are highly encouraged as this type of cooperation may well provide our pa-

tients with optimal care. Additionally, I would like to see more participation from our physical therapist assistant partners. Having begun my academic career in a physical therapist assistant program, I believe the PT-PTA partnership to be mutually beneficial to the health of our patients. I think our PTAs have much to offer and would ask our PTA members to consider submission of articles to *GeriNotes*. I would love to hear more from our PTA members who have achieved recognition of advanced proficiency in geriatrics. This kind of information would help to encourage other PTAs to become recognized specialists and better promote the physical therapist assistant's skills. It would be wonderful to hear from our members who have taken the Certified Exercise Expert for Aging Adults course. How has this benefited your patients? Have you had any difficulty incorporating what you learned into clinical practice? I would also appreciate hearing from those members who have chosen to further their education by receiving a transitional DPT degree. How has this education helped you in your career? How has the transitional DPT been of benefit to your patients? For those of you in direct access states, have you seen

any changes in the types of patients you are seeing without a direct referral? For those of you who participated in some kind of activity during National PT Month and/or Falls Awareness Month, what kinds of things did you do? For all in the Section, would you be willing to share ideas for activities that can benefit our profession and the geriatric patients we serve?

In short, I want to reach out to our members as our previous Editor did so well and continue the good works of this publication. Please let me know if you have ideas to share, ideas for focus issues, or any information that can improve *GeriNotes*. In this, my first issue, I have learned a lot. Thanks to everyone who helped me with content for this issue. I hope you find it interesting and that you are able to use some of this information to improve your practice and professional skills. Change is not always easy, and I have much to learn. But, with great people to help, I am hopeful that I can succeed in my efforts to help *GeriNotes* meet the needs of our members as it has done so well in the past. I look forward to the challenge and hope that our members will communicate often with questions, submissions, and ideas for improvement.

Election Results!

Please congratulate the following Section on Geriatrics members who will take office at the Member's Meeting on February 4, 2014 at CSM in Las Vegas:

Secretary

Ann Medley

Section Delegate

Steven Chesbro

Director

Danille Parker

Nominating Committee

Veronica Southard

The Nominating Committee wishes to greatly thank those who voted, and all candidates for their willingness to run and their strong interest in taking part in the future success of the Section on Geriatrics.

HEALTH REFORM AND THE GERIATRIC SYNDROMES: A CALL FOR INTERPROFESSIONAL PRACTICE

Kelly N. Poppaw, PT, DPT; Michael J. Shoemaker, PT, DPT, PhD, GCS

“Extremis malis extrema remedia: extreme remedies for extreme ills.” This Latin proverb carries an entirely new meaning to Americans, as the largest recession of the 21st century stares every socioeconomic class in the face. The expense of health care has significantly contributed to the United States’ debt crisis. Health care reform is therefore crucial to our nation’s economic recovery and fiscal stability. We spend the greatest amount of our gross domestic product in the world on health care, but attain no better than modest outcomes in nearly all key measures of health. It is in this context that the United States embarked upon an effort to reduce cost, improve access, and improve quality. Although implementation of some provisions in the Patient Protection and Affordable Care Act (PPACA) have been delayed, there are a variety of other solutions to help ensure that Americans have access to quality, affordable health care. However, such solutions are only found by first understanding the nature and cause of the problem, and then having the knowledge and courage to change. In terms of health care, the problem can no longer be viewed as the result of patients with chronic conditions consuming health care dollars, but rather as the lack of adequate and efficient care from current health care practitioners. This less-than-adequate and efficient care is the factor that drives patients into frequent hospital readmission, and hinders effective long-term management of chronic conditions.

Responsibility for the positive progression or the negative decline of a patient’s health status needs to be reevaluated. Blame is frequently placed upon the disease itself, patient compliance, or third party payer regulations and limitations, but clinicians are now beginning to look within and see that their own medical or rehabilitative interventions

share responsibility for these poor clinical and financial outcomes.

The intersection of the unmet needs of the frail elderly and health care reform efforts requires interprofessional practice. A true transformation of health care delivery that embraces interprofessional practice will require a rapid infusion of new graduates prepared for practice under this new model. This will require students to be trained as interprofessional practitioners by pioneering clinicians. This paper applauds the new American Physical Therapy Association Vision Statement’s Guiding Principle of collaboration, and serves as a call for competent and courageous health care professionals to be champions of interprofessional practice.

It is through interprofessional practice that patients with geriatric syndromes will have better outcomes, lower hospital or clinic readmissions, and lower total costs.

The 2003 Institute of Medicine Report¹ found that an increased number of unnecessary patient care errors and patient deaths were directly linked to miscommunication and poor collaboration among health care disciplines. Greiner and Knebel¹ state, “Errors led to tens of thousands of Americans dying each year, and hundreds of thousands suffering or becoming sick as a result of nonfatal injuries. Other studies have documented pervasive overuse, misuse, and underuse of services.” It is apparent that despite our nation’s substantial health care expenditures, critical needs of patients have gone unmet and unrec-

ognized within the health care system. This failure to meet the needs of our patients is a pride-cutting realization to all clinicians. In response to the Institute of Medicine’s seminal statement, the Interprofessional Education and Collaboration Movement was developed among academic universities and clinical partners across the nation. Interprofessional Education (IPE) is defined as “occasions when two or more professions learn with, from, and about each other to improve collaboration and quality of care.”^{2,3} With IPE, each discipline begins to take responsibility for these alarming statistics by requiring and encouraging health professions students to take part in interprofessional learning activities. Interprofessional Education teaches students that it is essential for health care professionals to practice to the full extent of their scopes of practice in a collaborative, patient-centered team, which requires all disciplines to understand the roles, job requirements, and scopes of practice of the other.

Although patients across the lifespan may benefit from effective interprofessional practice, the focus should be on the geriatric population, as they are not only the patients who have historically been most affected by miscommunication and poor collaboration among health care professionals, but they also represent the greatest proportion of health care expenditures. Many factors that contribute to patient care errors and deaths have been identified. Of these factors, miscommunication and poor collaboration among professionals are common and can only be addressed through interprofessional practice. Inouye et al⁴ state, “Intervention for geriatric syndromes requires human capital, rather than simply a new drug or technology.” It is through interprofessional practice that patients with geriatric syndromes will have better outcomes, low-

er hospital or clinic readmissions, and lower total costs. Inouye et al⁴ define a geriatric syndrome as “multifactorial health conditions that occur when the accumulated effects of impairments in multiple systems render [an older] person vulnerable to situational challenges.” By focusing assessment and treatment on one or two syndromes, instead of focusing on multiple contributing diagnoses, clinicians may juggle several systems that are involved in the patient’s presenting condition. In addition, planning treatment and interventions based specifically on geriatric syndromes may help the clinician to view the broader, more holistic picture of the patient to guide decision making.

The most common geriatric syndromes include pressure ulcers, incontinence, falls, functional decline, and delirium. Falls and delirium hold the highest number of occurrences, between 30% and 40% and 14% and 56% of patients, respectively.⁴ Delirium is unidentified in 66% to 70% of patients and then recorded in paper or electronic medical documentation in only 3% of patients.⁴ According to Inouye et al,⁴ “falls are the leading cause of unintentional injury, which ranks as the sixth leading cause of death in older people. In addition, falls lead to functional decline, hospitalization, institutionalization, and higher health care costs.” Although research on fall prevention interventions has demonstrated to result in better, cost-effective outcomes (up to 30% reduction), the majority of clinicians still do not implement fall prevention into patient care.⁴ Furthermore, a shortage has been noted in the number of physicians and nurses, who are both key clinicians in patient care. In this case, team work and collaboration among a larger primary care team that includes physical therapists and physical therapist assistants may be the only option to better address geriatric syndromes. Our nation’s elderly are in desperate need of competent, interprofessional teams that are able to more globally meet the needs of an increasingly frail population.

Previous models of health reform such as “managed care” were based on the opinion, clinical skills, and authorization of one clinician: the primary care physician. Outcome measures were

based solely upon physician financial performance. The physician was the “gate keeper” of a patient’s health care, meaning that all decisions for services provided by other disciplines were made by this primary care clinician. Although these physician-centered, Health Maintenance Organizations (HMOs) controlled costs, they also left patients with multisystem impairments hopeless. Coleman⁵ states, “Persons whose conditions necessitate complex, continuous management frequently require care from different health professionals in multiple settings.” Coleman⁵ provides an example:

A frail older person who sustains a hip fracture may require treatment from a diverse range of care professionals in a variety of settings, including an orthopedic surgeon, a hospitalist, hospital nurses, and a hospital physical therapist in an acute hospital; a skilled nursing facility (SNF) physician, SNF nurses, and a SNF physical therapist in a SNF; home care nurses, home care physical therapists, and home care occupational therapists for care delivered in the home, and a primary care physician and nurse in the primary care setting.

Coleman⁵ continues, “...a successful “handoff” of care between professionals in each setting is critical to achieving optimal outcomes for this patient population.” This description of transitional care is necessary, but readmission statistics show that these well-handled transfers of patients are not consistently performed. “...studies of transfers from SNFs back to acute care hospitals estimate that 19% of patients are transferred back within 30 days and as many as 42% within 24 months.”⁵⁻⁷ If poor transitional care characterized by poor communication among disciplines occurs in settings that have long relied upon multiple disciplines, it is likely that poor communication and collaboration among disciplines is an even greater problem among outpatient, ambulatory care practitioners. Primary care physicians are highly educated, well-respect-

ed, and needed to facilitate the best health care for patients. However, elderly patients with geriatric syndromes inherently require the coordination among the disciplines best suited to address the patients’ problems, and in the most cost effective way. In this case, a new era of patient-centered care and a new medical home can be established.

Asking clinicians to change the way they provide care creates tension, anxiety, and fear, and requires clinicians to actively seek out and embrace the contributions made by all members of the team. We must prepare for a new era of patient-centered care, combine our clinical forces, and attack the multisystem impairments of elderly patients together.

As a nation we have become anxious and apprehensive about the idea of reforming our entire health care system. Our minds are soiled with the burdens of a national recession. Our bodies are exhausted from lack of employment (physiology proves that lack of motion in it itself contributes to weakness). As health care professionals we can understand that fear is a natural yet stressful human response to change. So possibly, fear of the unknown lends a behavioral explanation for the delayed implementation of interdisciplinary collaboration in the health care field. Although opinions about the PPACA vary greatly, we all still have an opportunity to reform that way in which we approach the care of the elderly. Students of health professions have dreamed and envisioned. They have educated themselves. Students do not only believe in the possibility of interprofessional practice, more importantly, they expect it.

REFERENCES

1. Greiner AC, Knebel E, eds. *Health Professions Education: A Bridge to Quality*. Washington, DC: National Academy of Sciences; 2003.
2. Shoemaker MJ, Beasley J, Cooper M, Perkins R, Smith J, Swank C. A method for providing high-volume interprofessional simulation encounters in physical and occupational therapy education programs. *J Allied Health*. 2011;40(1):e15-e21.
3. Freeth D, Hammick M, Reeves S, Koppel I, Barr H. *Effective Interprofessional Education: Development,*

Delivery, & Evaluation. Oxford, UK: Blackwell Publishing 2005.

4. Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *J Am Geriatr Soc.* 2007;55:780-791.
5. Coleman EA. Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs. *J Am Geriatr Soc.* 2003;51:549-555.
6. Kramer A, Eilertsen T, Lin M, et al. Effects of nurse staffing on hospital transfer quality measures for new admissions. In: Health Care Financing Administration, ed. Appropriateness of Minimum Nurse Staffing Ratios for Nursing Homes. Baltimore, MD: Health Care Financing Administration; 2000:9.1-9.2.
7. Barker WH, Zimmer JG, Hall WJ, et al. Rates, patterns, causes, and costs of hospitalization of nursing home residents: A population-based study. *Am J Public Health.* 1994;84:1615-1620.



Kelly Poppaw is a recent graduate of the Doctorate of Physical Therapy Program at Grand Valley State University. She hopes to specialize in geriatric rehabilitation.



Mike Shoemaker is an assistant professor at Grand Valley State University. He is also co-chair of the West Michigan Interprofessional Education Initiative Simulation Workgroup.

GeriNotes Editorial Board Meeting

will be held on Tuesday,
February 4, 2014
during the
Combined Sections Meeting
in Las Vegas, NV
from 12:30 – 1:30 pm.

*Venetian Hotel
Sands Room 102*

Thinking of starting a Geriatric Residency? It's never been easier!

The Section's Home Study Courses are a convenient way to get much of the didactic content required in a Geriatric PT Residency Program

The **Section on Geriatrics** is proud to release the new edition of our popular **Focus** course covering physical therapist practice in geriatrics across the practice patterns, written by a talented group of board certified specialists who are leaders in the profession. **Special pricing** for Section members is available for residency programs when you contact the Section directly (*discount not available through the online Learning Center*).

The 6-monograph course includes:

Issue 1: *The Aging Musculoskeletal System* by **Karen Kemmis, PT, DPT, GCS, MS, CDE, CPRP, CEEAA**

Issue 2: *The Aging Neuromuscular System* by **Jason Hardage, PT, DPT, DScPT, GCS, NCS, CEEAA, and Mary Elizabeth Parker, PT, MS, NCS, PCS**

Issue 3: *The Aging Cardiovascular System* by **Ellen Strunk, PT, MS, GCS, CEEAA**

Issue 4: *The Aging Pulmonary System* by **John Lowman, PT, PhD, CCS**

Issue 5: *The Aging Integumentary System* by **Jill Heitzman, PT, DPT, GCS, CWS, CEEAA, FACCWS**

Issue 6: *Diabetes Across the Physical Therapy Practice Patterns* by **Pamela Scarborough, PT, DPT, MS, CDE, CWS, CEEAA**

A preview of all home study modules is available at learningcenter.apta.org/Courses.aspx. To learn more about developing a Geriatric Residency or Fellowship Program visit www.apta.org/educators/residencyfellowship/developing/.



3510 East Washington Avenue | Madison, WI 53704
Phone: 1-866-586-8247 | Fax: 1-608-221-9697 | geriatrics@geriatricspt.org

ADVERSE DRUG EFFECTS IN THE ELDERLY

Melanie Hughes, OT; Jennifer M Bottomley, PT, MS, PhD

The mean US life expectancy in 2010 is 78.24 years old up from 2000 at 76.74 years old.¹ The mean age is increasing for several reasons. One reason for the increase is the advance in treatment of many of the diseases of aging.² One of the advances is medication management. Per *Geriatric Rehabilitation: A Clinical Approach*, 3rd ed., individuals over 65 years old use more than 30% of all the prescriptions drugs prescribed in a year.³ Statistics vary in the number of medications the elderly take on a daily basis ranging from 5 to 7 for outpatients and up to 16 for in-patients.^{2,4-6} Polypharmacy has many different definitions based on who is defining the term. An old definition was, “the use of 2 (to 5) or more drugs.”³ A newer definition is “the use of a medication for which no clear indication exists.”³ Yet another definition is “the use of more than three drugs that have the potential to cause drug interactions and side effects.”² Another definition provided by Dr Jennifer Bottomley is when an individual takes more than one medication for the same purposes (for example 2 medications for high blood pressure).⁷ She further states that the use of multiple medications is more clearly defined as multipharmacy,⁷ which is what many of our elderly are experiencing.

“Why are our elderly taking so many medications?” is the question that is easily answered. Age. As individuals age, they are more likely to develop diseases involving the cardiac, pulmonary, skeletal, and neurological system. Heart disease is the number one cause of death in the United States with diabetes, stroke, and chronic obstructive pulmonary disorder included in the top 5 causes of death.⁷ Additionally, Alzheimer disease becomes more age related with increasing rates to 50% of those over 85 years old.⁷ The rates for antidepressant (thus the diagnosis of depression) use has risen from 21.9% to 47.5% in 10 years from 1996 to 2006 in elderly nursing home patients.⁸ The National Alliance on Mental Illness also states that 6.5 mil-

lion over the age of 65 years old has a form of depression.⁹ Furthermore, many of these diseases place individuals at risk for further complications. For example, individuals with congestive heart failure may also have challenges with diabetes, hypertension, hypercholesterolemia, or renal failure.⁷ Another example would be the obesity epidemic where 35.7% of Americans are obese.¹⁰ An obese individual is at risk for diabetes mellitus, coronary artery disease, hypertension, hyperlipidemia, atherosclerosis, and/or joint problems.⁷ Thus, a person could be on insulin for diabetes, an anti-hypertensive medication, an anti-cholesterol medication, hydrocodone or a nonsteroidal antiinflammatory drug for pain and inflammation, and maybe an anti-depressant due to all the medical problems and decreased physical activity. These patients can be labeled as medically complex where “one diagnosis may cause other pathophysiological conditions.”⁷

Besides the age and the chronic disease as reasons for polypharmacy, there are several more that can be cited including new drugs being developed, the increased use of herbal drugs and over-the-counter drugs to self-medicate, misuse of medications, poor choices by doctors when prescribing medications, over-prescription use, the necessity to treat side effects, and poor communication and relationship between doctors and patients, and patients requesting medications they have seen advertised.^{2,6}

One of the consequences of polypharmacy or multipharmacy is drug-drug interactions. One definition of drug-drug interaction is “the ability of a drug to modify the action or effects of another drug administered successively or simultaneously.”¹² Another article defined drug-drug interactions as “two or more drugs interacting in such a manner that the effectiveness or toxicity of one or more drugs is altered.”¹⁴ These interactions will be better explained later in this paper. The incidence of drug-drug interactions range from 5% to 63%

based on different researchers.^{5,10,12,14,16} Many articles discuss adverse drug reactions which is defined as “an appreciably harmful or unpleasant reaction, resulting from an intervention related to the use of a medicinal product.”¹⁷ Thus, drug-drug interactions can lead to adverse drug reactions that may lead to declining health, decreased functional abilities, increased number of hospitalizations along with longer stays, and increased overall health costs.^{4,5,6,11-15} Drug-drug interactions cause from between 2% to 10% of hospitalizations.^{5,12,14} Furthermore, certain drug combinations simply raise the risk of hospitalization to 3 times the risk when taken together.¹³ There are other drugs that increase the odds of being admitted to the hospital when taken in combination with other medications ranging from 3.7 up to 5.8.¹⁵ Looking at hospital stays, there are on average between one to 5 drug-drug interactions per stay.^{5,14,16} The total cost for drug-drug interactions can cost \$1 billion.¹² Additionally, drug-drug interactions while in the hospital increase costs by double and increase the length of stay from 8 to 15 days.¹⁶

The purpose of this paper is trifold. First is to educate the reader on reasons for drug-drug interactions. Second, to educate the reader of signs and symptoms of interactions based on commonly seen interactions. Third will be to educate the reader to what needs to be done to prevent or monitor these and why it is important for therapists to be aware of drug-drug interactions.

Drug-drug interactions are caused by one of two reasons--either pharmacodynamics or pharmacokinetics. Pharmacodynamics is the “response of the body to the effects of a drug at a given concentration.”³ The pharmacodynamics interaction looks at how the drugs react to each other.⁴ Drugs can either multiply the effect when using two similar drugs as in alcohol and a sedative both having sedative effects and is defined as having an “additive” effect.⁴ Or, on the other hand, the one medication can

stop the other from working effectively as in an ACE inhibitor and a potassium-sparing diuretic. This interaction can be called “antagonistic.”⁴ There are multiple ways that pharmacodynamics interaction works including COX-1-mediation of thromboxane synthesis, inhibition of serotonin into the platelets, reduction of glomerular perfusion, and inhibition of the renin-angiotensin system.⁴

“Pharmacokinetics describes how the body handles and disposes of a drug.”³ There are 4 ways that the body disposes of a drug: absorption, distribution, metabolism, and excretion.³ Two ways absorption is affected is the creation of complexes and the level of absorption at the membrane level.⁴ When complexes are created, the absorption can be slowed. An example given is alendronate for osteoporosis with either calcium from milk or mineral water or proton pump inhibitors that decreases the alendronate’s effectiveness.⁴ When absorption is affected at membrane level, the primary transport of P-glycoprotein (P-gp) is affected.⁴ This can inhibit or induce the P-gp or can be simply carried by the protein and is called a substrate. The typical scenario is that two medications are taken (a substrate and an inducer or a substrate and inhibitor) and the substrate’s effectiveness is increased or decreased leading to drug-drug interaction due to the body’s attempt to absorb the medication through P-gp.

Pharmacokinetics at the metabolic level is the next way medication can cause drug-drug interactions. “Inhibition of drug metabolism is a frequent cause of drug interactions.”⁴ Much of the drug metabolism is done through the cytochrome P450 enzyme (CYP450) that metabolizes 90% of drugs.¹⁸ There are more than 50 CYP450 enzymes that are primarily in the liver, but also in the small intestines, lungs, placenta, and kidneys.¹⁸ Each drug can be labeled as a substrate, inducer, or inhibitor of one of these CYP450 enzymes.^{4,18,19} Similarly as the pharmacodynamics, the pharmacokinetics of metabolism relates to when an inducer or an inhibitor of the CYP450 enzyme is given in combination with a substrate of the CYP450 enzyme the substrate will be more or less effective causing a potential drug-drug interaction. The level of interaction is based on the combination of medications and the amount of medication given. A drug can increase its effect,

inhibition, or induction by the dosing. There are more than 100 medications that are substrates of CYP450 enzymes, more than 50 inhibitors, and more than 20 inducers.^{4,18,19} Some medications can be substrates of different CYP450 enzymes for example amitriptyline (1A2 and 2D6) or multiple enzyme inducer like rifampin (2B6, 2C8, 2C9, 2C19, 2D6, and 3A4,5,7) which can make tracking the interactions difficult.^{4,18,19} Medications can also be both an inhibitor of one enzyme and a substrate of that same enzyme as is clarithromycin.^{4,19}

As the reader can see polypharmacy or multipharmacy involving multiple medications can have pharmacokinetic and pharmacodynamic interactions that may lead to drug-drug interactions. As many different diagnosis and medications that exist there are nearly that many potential interactions. Some interactions are minimal and some are so severe as to cause an adverse drug reaction like hospitalization. To complete the annotated bibliography and this paper, I completed a National Center for Biotechnology Information search using the search engine with “elderly” and “drug-drug interaction” as the criteria and over 58,000 articles were found.²⁰ The articles I chose for the content that focused on what I considered more common medications related to elderly (cardiac, antidepressants, etc), what causes interactions (CYP450), and general population trends. The next section of the paper will overview some of the common consequences of interactions and medications that cause the interactions.

BLEEDING

Bleeding is a common drug-drug interaction occurring in elderly due to the need for blood thinners to prevent clots to decrease risk of cerebrovascular accident or myocardial infarction. Drugs such as aspirin, warfarin, and clopidogrel are common medications recommended; however, each in combination with other drugs can cause bleeding. Aspirin causes a pharmacodynamics interaction with nonsteroid anti-inflammatory drugs (NSAIDs), selective serotonin reuptake inhibitor (SSRIs), and calcium channel blockers. The NSAIDs inhibit COX-1 protein synthesis reducing effectiveness of aspirin.⁴ The SSRIs affect platelet function increasing risk of bleeding when taken with warfarin or NSAIDs.⁴ Calcium

channel blockers inhibit the P-gp metabolism affecting aspirin as a substrate.⁴ Warfarin can either have a pharmacokinetic or pharmacodynamics reaction based on drug combinations. Warfarin is affected by CYP450 inhibitors amiodarone (arrhythmic), metronidazole (antibiotic), or fluconazole (antibiotic) that decreases the metabolism of warfarin keeping it in a person’s system longer thinning the blood.^{4,18} Additionally, warfarin can have a pharmacodynamics reaction when added to an anti-platelet medication such as clopidogrel or aspirin potentially thinning the blood too much resulting in overanticoagulation.¹⁴

DECREASED EFFECTIVENESS

A common theme of aspirin and NSAIDs is the combination with many drugs results in a pharmacodynamics interaction of decreasing effectiveness of medications.² A few medications that have proven decrease effectiveness include: beta blockers, thiazide and potassium sparing diuretics, and ACE inhibitors.⁴ Nonsteroid anti-inflammatory drugs with ACE inhibitors result in decreased blood pressure lowering effect.⁴ High dose aspirin and ACE inhibitors also decrease blood pressure lowering effect where low dose aspirin does not change effectiveness.⁴ Proton pump inhibitors can cause a pharmacokinetic reaction with antiplatelet medication of clopidogrel through the CYP450 enzyme causing decreased effectiveness of the antiplatelet medication increasing the risk of acute coronary syndrome.⁴ The medication alendronate for osteoporosis is affected in a pharmacodynamic way by calcium rich foods and proton pump inhibitors by decreasing the effectiveness putting the individual at risk for fractures.⁴ Both the calcium and the PPI reduce the absorption of the medication so less enters the system.⁴ Some medications, prodrugs, require metabolism in order to reach therapeutic levels.^{6,18} Opioids such as hydrocodone, codeine, dihydrocodeine, and tramadol are considered prodrugs.^{6,18} Any medication of the CYP2D6 enzyme group of the CYP450 that may include some SS-RIs, amiodarone, or quinidine will affect the metabolism which would decrease the resulting pain management level.^{4,6,18} Additionally, losartan, an antihypertensive medication, is also a prodrug and is a substrate of the CYP2C9 CYP450 enzyme that could be affected by an in-

hibitor of the same enzyme group such as amiodarone or fluconazole.^{4,6}

HEART COMPLICATIONS

Many heart failure patients are prescribed the combination digoxin and diuretics to improve heart contraction and to decrease pulmonary congestion and edema; however, this combination can lead to digoxin intoxication and hospitalization.^{12,13} The diuretic hydrochlorothiazide has the highest risk for side effects of all diuretics.¹³ This combination results in a pharmacodynamic interaction causing an electrolyte change mostly with potassium.¹³ Another combination that may cause digoxin intoxication is digoxin and amiodarone, both antiarrhythmic medications, which can cause a build-up of digoxin leading to toxicity.^{12,21} The combination of verapamil and clarithromycin, erythromycin or telithromycin can lead to a pharmacokinetic reaction of P450 leading to QT interval changes.¹⁸

The SSRIs and TCAs have shown to cause increased risk of death in patients with heart failure by increasing the serotonin levels and decreasing the effectiveness of the beta blocker.¹¹ This is a pharmacokinetic effect of the CYP450 enzyme groups and the inhibition of metabolism by the SSRI.⁴ Proton pump inhibitors including omeprazole, lansoprazole, and pantoprazole also create a pharmacokinetic effect by inhibiting other drugs metabolism and in combination with anticoagulant clopidogrel can lead to acute coronary syndrome.⁴

MYOPATHY/RHABDOMYOLYSIS

Simvastatin, another substrate of CYP450, is affected by antibiotics, clarithromycin, erythromycin, and telithromycin, which inhibit metabolism allowing an increase in simvastatin levels which become toxic potentially causing myopathy and/or rhabdomyolysis.¹⁸ The drug combination of simvastatin a substrate of P450 and verapamil an inhibitor can also lead to myopathy.

HYPOTENSION

Several drug-drug interactions can cause hypotension that can lead to adverse drug effects including falls which may lead to hospitalization for injury. The combination of ACE inhibitor (captopril or enalapril) with a loop diuretic (furosemide/Lasix) or a thiazide reacts in a pharmacodynamics level to cause a postural hypotension due to

changes in electrolytes.^{2,21} Additionally, propranolol, a beta blocker, and nifedipine, a calcium channel blocker, can cause a change in electrolytes resulting in hypotension or even bradycardia.^{2,22} Verapamil and other calcium channel blockers are a substrate of CYP450 and is affected by the inhibition antibiotics of clarithromycin, erythromycin, and telithromycin also causing potential hypotension by the built up of verapamil levels.^{15,18} Metoprolol and paroxetine can cause a orthostatic hypotension due to CYP450 interaction with the increase in serum levels of metoprolol.¹⁸

HYPERKALEMIA

The combination of ACE inhibitor and potassium sparing diuretic or aldosterone antagonists can cause a pharmacodynamic reaction of hyperkalemia that may lead to changes in heart rate or if severe enough the heart may stop.^{4,5,23}

EXTRAPYRAMIDAL SYMPTOMS

Risperidone and tramadol both have side effects of possible extrapyramidal symptoms (EPS).²¹ Extrapyramidal symptoms is a "group of side effects associated with antipsychotic medications. Extrapyramidal symptoms include parkinsonism, akathisia, dystonia, and tardive dyskinesia."²⁴ Adding a CYP450 inhibitor such as fluoxetine or paroxetine can increase the risk of symptoms due to decreasing the rate of metabolism and allowing the medication to build up in the system.¹⁸

SEROTONIN SYNDROME

Serotonin syndrome is a group of symptoms including confusion, agitation or restlessness, dilated pupils, headache, changes in blood pressure and/or temperature, nausea and/or vomiting, diarrhea, rapid heart rate, loss of muscle coordination or twitching muscles, shivering and goose bumps, and heavy sweating that can result from some medication combinations.²⁵ The SSRIs taken together (for example amitriptyline and fluoxetine) or, tramadol, or triptans with other medications can act in a serotonergic effect can have this potentially life threatening effect.¹²

MULTISYMPTOM/MULTI-EFFECTS

Amiodarone is a medication for the treatment of ventricular fibrillation and was found in several articles indicating potential interactions.^{4,5,12,18} Amio-

darone is metabolized by the CYP450 enzyme group as an inhibitor and also the P-gp protein as an inhibitor.⁴ Due to this inhibition, amiodarone can cause multiple significant changes in heart rhythm, myopathy, digoxin intoxication, bleeding, and impairment of effectiveness of other medications.²⁴ The combination of beta blockers and SSRIs (which are pharmacokinetic inhibitors of CYP450) can lower blood pressure and cause bradycardia.⁴ Fluoxetine, an inhibitor of CYP450, in combination of the antipsychotic clozapine can cause potentially fatal symptoms of changes in heart rate, abnormal movements, and changes in blood pressure.⁴ Quinolones inhibit CYP450 enzyme and with combination of theophylline, used for treatment of chronic asthma and lung diseases can create cardiac and gastrointestinal symptoms.^{4,21}

TREND

Four of the articles that were reviewed showed some common connections when discussing drug-drug interactions. For the elderly, cardiac medications are the most common medication prescribed with over 285 million prescriptions written in 2010.²⁶ Diuretics (loop, thiazides, and potassium-sparing), ACE inhibitors, digoxin, antiplatelet medications, and anticoagulants can account for most of the common drug-drug interactions followed closely by aspirin and NSAIDs.^{2,5,12,14} Most of these interactions are of the pharmacodynamic interaction type affecting potassium, COX-1 binding, and clotting levels.² The conclusion of this trend is that individuals taking any form of cardiac medication should be aware of potential drug-drug interactions and be closely monitored by a physician.

In the small research I did to help to understand drug-drug interactions better, I found 84 different combinations that could lead to potential adverse drug effects. There were so many, I could not begin to understand the dynamics of interaction with each combination and could not clarify all within this paper. With the large amount of medications that cause pharmacodynamics interactions with electrolytes and with medications working with and against each other and then adding the pharmacokinetics of CYP450 and the more than 100 medications metabolized through that system there are probably 5 times

this amount of combinations looking at each individual medication.

It is important that patients, doctors, and therapists understand the reasons and consequences of drug interactions as stated earlier in the paper. Once those are understood, it leads to prevention and monitoring of changes made to a patient's drug regime. Some hospitals are introducing data-bases to alert physicians to potential drug-drug interactions.^{5,14} Many of these data-bases create ratings to level of severity of drug-drug interactions. Micromedex, GALDAT, DrugDigest, Drugs, and Medscape are 5 computer-based programs that have been developed to alert the user to potential drug-drug interactions.^{2,5,14} The GALDAT rates the drug-drug interactions on a 6 category rating scale.⁵ The most serious is category 1 identified as "contraindicated" and the least serious is category 6 "no measures required."⁵ When researchers used this rating system it was found that most drug-drug interactions occurred in the category 3 "adjustment required."⁵ Two studies used Micromedex system that used a low, moderate, or severe rating scale; during that study most interactions occurred in the moderate range.^{2,14} In one study, the physicians were watched on how they reacted to alerts provided by the GALDAT system. Researchers concluded that 91% of all alerts were overridden by the physician.⁵ Many of the drug-drug interactions could have been prevented simply by monitoring and adjustments based on labs.⁵ The AARP has created a drug checker website that allows an individual to place all their medications into their system and drug-drug interactions will be rated by severe, moderate, or minor.²⁷ This is a useful website for therapists or patients to check their medications to help monitor changes. Additionally, CVS has their own drug checker site and it also has a way to keep track of all of an individual's prescription history.²⁸ This can be useful for someone changing medications but unable to track the changes. The CVS, similar to AARP, allows the user to input their prescriptions and rates of interaction from major to moderate to low.^{27,28} Both the AARP and CVS websites provide symptoms to look for when monitoring interaction.

Many articles make recommendations both in a general and a drug specific manner on what to do to prevent drug-drug interactions. Drug specific recommendations include that if a pa-

tient is in need of an antidepressant while being treated for heart failure then a tricyclic antidepressant (TCA) should be chosen over a SSRI.¹¹ If a heart failure patient requires the combination of digoxin and a diuretic, then a potassium-sparing is the least risky (although still has a 1.72 odds ratio of hospitalization).¹¹ If a patient is on a calcium-channel blocker for hypertension or coronary artery disease and is in need of a macrolide antibiotic the best choice is azithromycin over erythromycin and clarithromycin.¹⁵

When discussing general guidelines for prevention of drug-drug interactions, the primary suggestion was to include periodic review of medications by physician and look at efficacy of medication and adjust for drug-drug interactions as needed.² Physicians must monitor lab values when a medication is added that has a potential to change lab values.⁵ For example, since warfarin has a small window of efficacy as indicated by INR (2.0-3.0) and some medications (eg, Fluconazole) can alter the INR pharmacokinetically or pharmacodynamically putting the patient at risk for bleeding, then lab values should be more closely monitored during the time on the new medication.^{4,12,14,18,29} It is also important for physicians to know what medications their patients are taking and for patients to communicate to different physicians. A simple example provided was a patient on warfarin with previously stable INR values that suddenly became unstable; the patient was found to have started fluconazole for an infection.¹⁸ It could have been very likely that this patient failed to inform their family doctor they were on warfarin and the physician, without knowing this, gave this patient a CYP450 inhibitor altering the metabolism of warfarin. Many of the articles state the simple fact that polypharmacy is the biggest predictor of drug-drug interactions and anything that can be done to reduce polypharmacy can reduce interactions.^{2,3,5,6,12,14,16}

Physicians and therapists can help patients detect interactions. Tom Lynch⁶ recommends 4 questions to help with this. First, identify the nature of the interaction looking at drugs, diseases, food, and nutrition. Second, how would the interaction occur? This looks at pharmacokinetics or pharmacodynamics that were discussed earlier. Third, are there potential or clinical symptoms that can be monitored? This looks at symp-

toms as discussed in the medication part of this paper and the risk factors involved with the medically complex patient. And lastly, is there a plan for monitoring those changes? Should labs be taken? Should blood pressure monitored for changes? Who will monitor changes--the patient or family member?

Additionally, Lynch⁶ recommends 5 steps for medication management for primarily opioid therapy but many can be modified to other medications. First, "start low, go slow."⁶ Basically, when it comes to medications it is better to begin with a low dose and slowly move up based on clinical changes or lack thereof. Second, "identify all medications, with a focus on medications that alter CYP450 activity."⁶ This goes back to the facts stated earlier in this paper that there are substrates of CYP450 and can be affected by inducers in quickening metabolism decreasing effectiveness or affected by inhibitors decreasing metabolism into their active drug which also decreases efficacy.^{4,6} Any new medication should be cross-referenced with old medications using a site like the IU or CVS or AARP or one of the hospital based computer programs for potential drug-drug interactions. Third, "consider route of administration" which discusses how the medication is entering the system and that oral drug intake has a higher probability of interaction than does intravenous, rectal, or buccal.⁶ Fourth, "avoid errors" means not only completing step two but also making sure all medications including nonprescriptions are accounted for to complete this step. As stated earlier, many over-the-counter medications (eg, aspirin, NSAIDs) can cause serious drug-drug interactions and need to be accounted for when changing medications. Lastly, "follow-up" discusses the monitoring of the new medication and both the positive and negative changes resulting from that medication.⁶ This might be a subjective pain rating scale (0-10), changes in blood pressure (hypotension or hypertension), or lab values (as in warfarin).

Can polypharmacy or multipharmacy be reduced? Garfinkel et al³⁰ completed an interesting study in 6 geriatric nursing departments. They used a geriatric-palliative approach where they reviewed medications for each patient and symptoms with the purpose to discontinue as many medications as possible. In 119 patients, they were able to discontinue 332 medications with

no significant drug effects.²⁹ They had “failure” zones for each medication and monitored patients accordingly to make sure the medication discharge was safe and effective.¹⁹ They had an 18% failure rate where medications needed to be resumed.¹⁹ Although not studied directly, they received reports of changes for the positive in alertness and decreased agitation.¹⁹ They also showed a decrease in cost to the facility due to the reduction in medications.¹⁹ So, the answer is yes, that some patients can be taken off medications safely based on change in health status. Additionally, we know that life-style changes can alter cholesterol, high blood pressure, and risk for heart problems and can reduce the need for medication.

Another thing to look at while examining drug-drug interactions is some of the individual medications that are on the potential medication list are also on the Beers’ Criteria. The Beers’ Criteria is a listing of medications that “should be avoided in older people.”³² Examples of medications that have potential drug-drug interactions are also on this list include: amiodarone, digoxin, spironolactone, and amitriptyline.³² Additionally, the Beers’ Criteria does not take into account the drug-drug interactions that could potentially make the list extend from the 53 medications or medication classes to easily more than 100 combinations that could create an “avoid” recommendation.³¹

Therapists spend two to 3 hours per day with a patient. We monitor vitals, have discussions with patients, and monitor movements. We have the ability to see the small changes (good and bad) that our patients experience. We speak with physicians and provide updates to positive and negative changes in our patients. We even help patients to understand their medications better. In order to make recommendations and help our patients, an understanding of drug-drug interactions at the pharmacodynamic and pharmacokinetic levels and having a good knowledge of what medications are more likely to cause interactions should be a vital part of a therapist’s knowledge base.

REFERENCES

1. World Bank. *Life Expectancy*. 1-17-13. Available at http://www.google.com/publicdata/explore?ds=d5bncppjof8f9_&met_y=sp_dyn_le00_in&idim=country:USA&dl=en&hl=en&q=life%20expectancy#!ctype=1&strail=false&bcs=d&nselm=h&met_y=sp_dyn_le00_in&scale_y=lin&ind_y=false&rdim=region&idim=country:USA&idim=region:NAC&ifdim=region&tdim=true&hl=en_US&dl=en&ind=false. Accessed March 16, 2013.
2. Venturini CD, Engroff P, Ely LS, et al. Gender differences, polypharmacy, and potential pharmacological interactions in the elderly. *Clin Sci*. 2011;66(11):1867-1872.
3. Lewis CB, Bottomley JM. *Geriatric Rehabilitation: A Clinical Approach*. 3rd ed. Upper Saddle River, NJ: Pearson Education, Inc.; 2008.
4. Cascorbi I. Drug interactions-Principles, examples and clinical consequences. *Dtsch Arzteblatt Int*. 2012;109(33-34):546-556.
5. Oertle M. Frequency and nature of drug-drug interactions in a Swiss primary and secondary acute care hospital. *Swiss Med Wkly*. 2012;142:w13522.
6. Lynch T. Management of drug-drug interactions: Considerations for special populations-Focus on opioid use in the elderly and long term care. *Am J Manag Care*. 2011;17:S293-S298.
7. Bottomley JM. *Assessment and Intervention for Geriatric Clients with Multiple Diagnoses*. University of Indianapolis College of Health Sciences Postprofessional Program. May 15-17, 2013.
8. Boyce RD, Handler SM, Karp JD, Hanlon, JT. Age-related changes in antidepressant -pharmacokinetics and potential drug-drug interactions: A comparison of evidence-based literature and package insert information. *Am J Geriatr Pharmacother*. 2012;10(2):139-150.
9. Duckworth K. *Depression in Older Persons Fact Sheet*. National Alliance on Mental Illness. http://www.nami.org/Template.cfm?Section=By_Illness&template=/Content-Management/ContentDisplay.cfm&ContentID=7515. Accessed March 13, 2013.
10. Centers for Disease Control and Prevention. *Adult Obesity Facts*. Updated August 13, 2012. <http://www.cdc.gov/obesity/data/adult.html>. Accessed March 20, 2013.
11. Fosbøl EL, Gislason GH, Poulsen HE, et al. Prognosis in heart failure and the value of β -blockers are altered by the use of antidepressants and depend on the type of antidepressants used. *Circ Heart Fail*. 2009;2:582-590.
12. Neto PRO, Nobili, A, Júnior DPL, et al. Incidence and predictors of adverse drug reactions caused by drug-drug interactions in elderly outpatients: A prospective cohort study. *J Pharm Pharmaceut Sci*. 2012;15(2):332-343.
13. Wang MT, Su CY, Chan ALF, Lian PW, Leu HB, Hsu YJ. Risk of digoxin intoxication in heart failure patients exposed to digoxin-diuretic interactions: A population-based study. *Br J Clin Pharmacol*. 2010;70(2):258-267.
14. Mateti UV, Rajakannan T, Nekkanti H, Rajesh V, Mallaysamy SR, Ramachandran P. Drug-drug interactions in hospitalized cardiac patients. *J Young Pharm*. 2011;3(4):329-333.
15. Wright AJ, Gomes T, Mandani MM, Horn JR, Juurlink DN. The risk of hypotension following co-prescription of macrolide antibiotics and calcium-channel blockers. *Can Med Assoc*. 2011;183(3):303-307.
16. Pergolizzi JV. Quantifying the impact of drug-drug interactions associated with opioids. *Am J Manag Care*. 2011;17:S288-S292.
17. Edwards IR, Aronson JK. Adverse drug reactions: definitions, diagnosis, and management. *Lancet*. 2000;356(9237):1255-1259.
18. Lynch T, Price A. The effect of cytochrome P450 metabolism on drug response, interactions, and adverse effects. *Am Fam Physician*. 2007;76(3):391-396.
19. Indiana University: Department of Medicine. *Cytochrome P450 Drug Interaction Table*. Updated 2003. www.drug-interactions.com. Accessed March 20, 2013.
20. National Center for Biotechnology Information, U.S. National Library of Medicine. <http://www.ncbi.nlm.nih.gov/>. Accessed March 19, 2013.
21. MedConnections Inc. *iPharmacy*. 2012. Kindle Application. Accessed March 19, 2013.
22. Leon MB, Rosing DR, Bonow RO, Epstein SE. Combination therapy with calcium-channel blockers

- and beta blockers for chronic stable angina pectoris. *Am J Cardiol.* 1985;55(3):69B-80B.
23. Medline Plus. *High Potassium Levels*. US National Library of Medicine and National Institute for Health. March, 22, 2013. <http://www.nlm.nih.gov/medlineplus/ency/article/001179.htm>. Accessed March 27, 2013.
 24. The Free Dictionary. *Extrapyramidal symptoms (EPS)*. Farlex, INC. 2013. <http://medical-dictionary.thefreedictionary.com/Extrapyramidal+symptoms>. Accessed March 27, 2013.
 25. WebMD, LLC. Depression Resource Center: *What is Serotonin Syndrome?*. WebMD, LLC. 2005-2013. <http://www.webmd.com/depression/guide/serotonin-syndrome-causes-symptoms-treatments>. Accessed March 30, 2013.
 26. Rubin A, Rubin, H. *Prescription Drugs and the Elderly*. April 9, 2012. www.therubins.com/geninfo/eldpresc.htm. Accessed February 23, 2013.
 27. AARP. Drug Interaction Checker. AARP.org. No update given. <http://healthtools.aarp.org/drug-interactions>. Accessed March 19, 2013.
 28. CVS Pharmacy. *Drug Information Center: Drug Interactions*. MED-counselor. <https://www.cvs.com/drug/interaction-checker.jsp>. Retrieved March 27, 2013.
 29. Health Engine. *INR test*. Health Engine. 2013. http://healthengine.com.au/info/INR_Test. Accessed March 22, 2013.
 30. Garfinkel D, Zur-Gil S, Ben-Israel J. The war against polypharmacy: A new cost-effective geriatric-palliative approach for improving drug therapy in disabled elderly people. *IMAJ*. 2007;9:430-434.
 31. Gallagher PF, Barry PJ, Hartigan I, O'Mahony D. Inappropriate prescribing in an acutely ill population of elderly patients as determined by Beer's Criteria. *Age Aging*. 2008;37:96-101.
 32. Fick D, Semla T, Beizer J, et al. American Geriatrics Society updated Beers' Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2012;1-16.



Melanie Hughes is an Occupational Therapist and is currently working with Geriatrics in a skilled nursing facility working with short-term rehabilitation to home clients and long-term residents to return to prior functional levels. I am working toward my Masters in Occupational Therapy through the University of Indianapolis. I live in Spencer, Indiana with my husband and two children.



Jennifer M. Bottomley is an independent consultant in geriatric rehabilitation, an educator, and has authored numerous articles, chapters, and texts. She currently serves on an Interdisciplinary Medicare Advisory Board for the White House, assisting in recommendations towards Health Care Reform.

CSM PROGRAMMING 2014

Sue Wenker, PT, MS, GCS

We are anticipating another great year of programming at CSM 2014! Review this chart to start your planning!

Date	Time	Session Title
Sunday, Feb 2	8:00AM-5:30PM	Tai Chi Fundamentals® Program Level One A Functional Approach to Neuro Part 1
Monday, Feb 3	8:00AM-5:30PM	Tai Chi Fundamentals® Program Level Two A Functional Approach to Neuro Part 2—Mentoring: Residency & Fellowships
	6:30PM-7:30PM	Balance & Falls SIG Meeting
Tuesday, Feb 4	6:30AM-8:00AM	GCS Breakfast
	8:00AM-10:00AM	Platforms — BOD Meeting 1 HPW SIG: EBP's to Enhance PT Practice: I EDGE & PTNow – Management of Hip fracture BF SIG: EBP's to Enhance PT Practice: II
	11:00AM-1:00PM	Seating and Mobility for Geriatrics— WALKING SPEED IN CLINICAL PRACTICE
	3:00-5:00PM	Members Meeting (First 30 minutes for members only)
	6:30PM-10:00PM	Platforms — Support Payment: Tests for Aging Adults
Wednesday, Feb 5	8:00AM-10:00AM	Motivating Apathetic & Depressed Clients Clinicians, Cognition, and Fall Risk
	11:00AM-1:00PM	Student Forum: The Passion of Geriatrics — Standardized Practice – Optimal Outcomes
	3:00-5:00PM	CEEA Reception — Health & Wellness SIG Meeting
	6:30PM-7:30PM	BOD Meeting Two — Bone Health Sig: Meeting
Thursday, Feb 6	6:30AM-8:00AM	Bone Health SIG: Exercise and Bone: From Jumping to Shaking to Progressive Resistance
	8:00AM-10:00AM	Risk of Falling Recommendations: GeriEDGE
	11:00AM-1:00PM	Pilates Functional Outcome Measurement (FMOM)
	3:00-5:00PM	Falls: Identification, Prevention & Treatment Outcome Tools: MDC & MCID — Management of the Complex Patient/Family

THYROID DYSFUNCTION IN OLDER ADULTS

Debra L. Gray, PT, DHSc, DPT; Jennifer M Bottomley, PT, MS, PhD

Thyroid dysfunction is the most common endocrine disorder, affecting more than 20 million Americans with associated health care costs estimated to be more than \$10 billion annually.¹ Thyroid dysfunction can be classified as hyperthyroidism that is characterized by increased thyroid hormones (TH) and decreased thyroid stimulating hormone (TSH) and hypothyroidism with the opposite hormonal abnormalities (low TH and high TSH). Changes in thyroid function including hormone production, metabolism, and action are related to aging. The prevalence of thyroid dysfunction is greater in postmenopausal women. A 2003 study found an incidence of 2.4% clinical thyroid disease and 23.2% subclinical disease in that population. Among those postmenopausal women with subclinical conditions, 73.8% had hypothyroidism and 26.2% had hyperthyroidism.² This paper will review normal thyroid function, briefly discuss hyperthyroidism, and then will focus on the more common geriatric condition of hypothyroidism with a review of the causes, signs and symptoms, diagnosis, medical treatment, and clinical implications of particular relevance to physical therapy.

The thyroid gland is located in the anterior neck area just below the larynx. Its main function is to secrete tetraiodothyronine (T₄) and triiodothyronine (T₃). Eighty percent of T₃ is produced by extrathyroidal deiodination of T₄. T₃ interacts with nuclear T₃ receptors in multiple target tissues. Thyroid function is regulated by the hypothalamus and the pituitary gland. Thyrotropin releasing hormone (TRH) from the hypothalamus stimulates the pituitary to secrete TSH in response to T₃ levels within thyrophic cells in the pituitary. The actions of thyroid hormone are significant and varied. It promotes normal growth and development, regulates heart rate and cardiac output, maintains ventilator responses to hypoxia and hypercapnia, modulates the basal metabolic rate, modulates the metabolism of lipids and carbohydrates, stimulates bone remodeling, and has an effect on gastrointestinal

and kidney functions.²

In normal aging, TSH and T₃ levels decline but T₄ levels remain the same. There is an age-related decline in TSH secretion by the pituitary gland and a shift in the circadian rhythm of TSH secretion in which nocturnal TSH peak time is earlier. The mechanism behind the altered TSH secretion is unknown and may be due to reduced TRH from the hypothalamus. Even though the decreased TSH results in lower T₄ production, the concentration stays the same due to decreased degradation of T₄ with age. There is also an age-related increase in the prevalence of anti-thyroperoxidase (anti-TPO) and anti-thyroglobulin (anti-TG) antibodies, particularly in postmenopausal women, resulting in an increased incidence of hypothyroidism. For reasons yet unknown, thyroid antibodies are rarely found in centenarians but are frequently found in hospitalized elderly patients.³

Hyperthyroidism is one form of thyroid dysfunction. It increases in prevalence in the elderly with approximately 3% of those over the age of 60 years having the condition. It is diagnosed through measurement of TSH blood levels with 0.1-0.45 mU/L being considered subclinical and <0.1 mU/L designated as overt hyperthyroidism. Common causes of hyperthyroidism in older adults include multinodular goiter, Graves' disease, or excess iodine intake associated with medications or imaging contrast agents. Nonthyroidal illnesses, poor nutrition, and medications such as glucocorticoids should be excluded as possible causes of low TSH in differential diagnosis.⁴

Signs and symptoms of hyperthyroidism in postmenopausal women include weight loss, nervousness, increased perspiration, cardiac arrhythmias, alopecia, and diarrhea. Subclinical hyperthyroidism in older women is often unrecognized due to lack of symptoms or similarity to symptoms often associated with menopause.² The most significant clinical manifestations of hyperthyroidism include cardiac dysfunction, increased risk of thromboembolic

complications, and reduced bone mineral density (BMD).^{2,4} The combined effect of increased TSH and decreased estrogen put postmenopausal women at significantly greater risk for osteoporosis and related complications.²

Treatment of hyperthyroidism is with TH suppression therapy. Currently there is insufficient evidence to demonstrate a definite link between treatment of subclinical hyperthyroidism and reduction of cardiac dysfunction, particularly atrial fibrillation. However, since subclinical hyperthyroidism in adults over the age of 60 years has been associated with increased 10-year mortality, many physicians recommend TSH suppression treatment even in mild cases.⁴ Estrogen replacement is also frequently recommended for postmenopausal women with even mild hyperthyroidism due to estrogen's positive effect on bone health.²

Hypothyroidism is the more prevalent form of thyroid dysfunction in the aging population. The most common cause of hypothyroidism is thyroiditis in which the thyroid gland's cells are damaged by inflammation resulting from a chronic autoimmune condition. Other causes of hypothyroidism include certain drugs such as lithium and amiodarone, iodine deficiency, radiation treatments to the head and/or neck, radioactive iodine used to treat hyperthyroidism, and surgical removal of all or part of the thyroid.

Early symptoms of hypothyroidism include constipation due to decreased GI motility, increased sensitivity to cold, general fatigue, joint and/or muscle pain, weakness, depression, and weight gain. If the condition persists without treatment, later symptoms are commonly decreased taste and smell; hoarseness of voice; puffiness of the hands, feet, and face; and slow speech. Physical examination often shows the following signs: atrophic thyroid gland upon palpation, delayed relaxation phase of deep tendon reflexes, bradycardia, diastolic hypertension, thin and brittle hair and/or nails, pale and/or dry skin, and thinning of the eyebrows. Routine

laboratory test results may be abnormal. Hypercholesterolemia, hyponatremia, hyperprolactinemia, hyperhomocysteinemia, hypoglycemia, and elevated creatine phosphokinase are often found.³

Hypothyroidism in older adults may be overlooked or misdiagnosed because it often has a more insidious onset than in younger populations, there are frequently co-morbidities with similar symptoms, and attribution of many of the symptoms to normal aging.⁴ A rare but potentially life threatening complication of hypothyroidism is myxedema coma. It may result from an infection, illness, hypothermia, or untreated hypothyroidism. Signs of myxedema coma include below normal body temperature, decreased respiratory rate, hypotension, low blood sugar, and unresponsiveness.³

Laboratory tests of thyroid function are the primary diagnostic method for hypothyroidism when prompted by clinical signs and symptoms and/or abnormal findings on routine screening. Serum TSH and T4 levels are the most common tests. The range of normal TSH levels is 0.35 – 4.5 mU/L. An elevated TSH level indicates the likelihood of hypothyroidism but assumes normal hypothalamus and pituitary functioning. Testing T4 provides additional diagnostic confirmation. Because total T4 levels can be affected by common protein binding abnormalities, free T4 is measured instead. The normal range for free T4 is 11-24.⁵ Elevated TSH with low or normal T4 confirms the diagnosis. Malnutrition, chronic illness, and use of some medications can affect TSH and T4 levels in the elderly. Drugs that may alter thyroid function test results include lithium, amiodarone, glucocorticoids, dopamine, estrogens, heparin, and propranolol.⁴ Less frequent diagnostic tests include blood tests for the presence of anti-thyroid antibodies or calcitonin levels and imaging such as a thyroid ultrasound.

In cases in which free T4 is normal and TSH if elevated but <10 mU/L, the condition is considered to be subclinical hypothyroidism. Subclinical hypothyroidism is more common in women over the age of 80, in Caucasians, and in populations with iodine deficiency. Some of the possible conditions related to subclinical hypothyroidism are cardiac dysfunction, atherosclerosis, hypercholesterolemia, cognitive and depressive disorders, and conversion to overt hypothyroidism. Adults 55 years and



older will progress from subclinical to overt hypothyroidism at a rate of about 8% per year.⁴

Because of the nonspecific signs and symptoms and the chronic complications associated with untreated hypothyroidism, the American Thyroid Association recommends all adults be screened for TSH levels at age 35 and every 5 years thereafter. The American College of Physicians supports screening of women over the age of 50 years. No national guidelines currently exist and when and who to screen for thyroid dysfunction remains controversial.^{1,6}

Medical treatment of hypothyroidism is replacement of thyroid hormone with a synthetic alternative called levothyroxine taken orally and daily. Levothyroxine is absorbed in the small intestine and has a 7 day half-life due to plasma protein binding. It is metabolized once it reaches the target tissues. Dosage of levothyroxine is based on bodyweight and age. Prescribers are urged to begin treatment at the lower end of the dosage range and make adjustments based on laboratory monitoring of TSH and T4

levels. Once the appropriate dosage is established, annual monitoring is recommended or more often if symptoms of over medication develop or continued low levels persist. To maximize absorption of levothyroxine, it should be taken on an empty stomach and should not be taken with certain drugs and supplements such as iron, calcium carbonate, cholestyramine, several anti-seizure medications (eg, phenobarbital), as well as dietary fiber and soy products.^{3,4}

Thyroid hormone replacement in cases of subclinical hypothyroidism is controversial. Research regarding the benefit of levothyroxine to prevent the complications associated with hypothyroidism has not been definitive. Current guidelines do not recommend thyroid hormone replacement if the patient has normal T4 levels and a TSH level below 10 mU/L.^{4,6} Those in favor of treatment for patients with TSH levels of 5-10 mU/L argue that levothyroxine may prevent the progression to overt hypothyroidism and lessen the negative effects on the cardiovascular system and may improve quality of life by reducing



PHYSICAL THERAPY
UNIVERSITY OF MINNESOTA

APTA
American Physical Therapy Association
CREDENTIALLED RESIDENCY PROGRAM

CLINICAL RESIDENCY IN GERIATRIC PHYSICAL THERAPY

The University of Minnesota Program in Physical Therapy is seeking applications for our expanding Geriatric Clinical Residency. This 12 month program (September – August) will provide residents extensive didactic education, clinical practice, service learning, and individual mentoring in the area of geriatric physical therapy and issues related to aging. Clinical Faculty are geriatric experts in a variety of disciplines. New graduates and experienced clinicians are encouraged to apply. Resident graduates will be prepared to sit for the GCS exam. Residents will earn a salary with benefits, 2 state conference registrations, CSM registration & travel assist, 230+ CEU credits, and pay minimal tuition. On-site housing is available.

For an application or further information, please contact
Residency Director,
Becky Olson-Kellogg, PT, DPT, GCS at
612-624-6591 or olso0184@umn.edu

The University of Minnesota's Geriatric Clinical Residency is credentialed by the American Physical Therapy Association as a post professional residency program for physical therapists in geriatrics.

Applications due March 31 each year

the symptoms experienced by many patients.^{1,3,6} Thyroid hormone can increase myocardial oxygen demand that can lead to angina pectoris or arrhythmias in older individuals so replacement therapy should begin conservatively and progress cautiously in that population.⁴

A number of clinical features of hypothyroidism can be seen in each of the systems most often treated by physical therapists: musculoskeletal, neuromuscular, cardiopulmonary, and and to a lesser extent the integumentary system. In addition, hypothyroidism often produces neurological and immunological effects that may impact physical therapy.

Skeletal muscle is a target tissue for thyroid hormone. Physical exercise is known to affect gland activity and hormone production. As previously stated, arthralgia and muscle weakness are common complaints of individuals with hypothyroid conditions. Also, many patients report exercise intolerance and fatigue. Duyff et al⁷ found that more than 75% of patients diagnosed with hypothyroidism had muscle weakness. A number of structural and biochemical changes have been observed in humans and animals with thyroid dysfunction. In hypothyroid muscles, mitochondrial enzymes are decreased, particularly in slow twitch muscles. There appears to be a hormone-dependent bioenergetics abnormality in hypothyroid muscle.⁸ A study of hypothyroid cat soleus muscles found altered mechanical properties. There was slower time-to-peak contraction and half-relaxation times, higher muscle tension, and higher fatigability than in normal muscles.⁹ Caraccio et al¹⁰ found elevated blood lactate levels in subclinical hypothyroid patients during submaximal exercise and suggested "the known structural alterations of skeletal muscle, more pronounced with frank hypothyroidism but also present in sHT (subclinical hypothyroidism) may underlie the muscular symptoms frequently reported by sHT patients."^(p 461) That same study found that T4 replacement did reduce the subjective symptoms of patients even though the metabolic response to exercise was not improved. Thyroid hormones are also essential for normal bone growth and remodeling. However, excess thyroid hormone is associated with increased risk for osteoporosis. Postmenopausal women taking thyroid replacement should be carefully dosed and monitored.² In addition, entrapment syndromes, such as carpal tunnel syndrome and facial nerve

palsy, have also been associated with hypothyroidism.¹¹

Thyroid hormone plays a key role in cardiovascular homeostasis by influencing myocardial contractility, heart rate, diastolic function, and systemic vascular resistance. Ciloglu et al¹² studied the effect of exercise on thyroid hormones in young adult male athletes. They found an increase in TSH values at moderate (70% max HR) and maximum (90% max HR) exercise and an increase followed by a decrease in T3 and an increase in T4 levels. Adverse effects of hypothyroidism on the cardiovascular system have been demonstrated in a number of research studies. Meena et al¹³ found significant left ventricular diastolic dysfunction both at rest and during exercise. With hormone replacement therapy, the dysfunction improved in cases of subclinical hypothyroidism but not in those with overt hypothyroidism. Low T3 levels with normal T4 and TSH levels have been linked to heart failure.¹⁴ Low thyroid hormone has also been linked to increased total cholesterol and low-density lipoprotein (LDL) along with decreased high-density lipoprotein (HDL) which are known cardiovascular disease risk factors. Subclinical hypothyroidism has been strongly associated with arteriosclerosis and myocardial infarction in older women.² However, the increased cardiovascular risk related to hypothyroidism appears to be for patients younger than age 70 years. Studies have shown there to be no additional risk for those ages 70-80 years and that there may actually be a protective benefit of having high TSH levels in people over the age of 80 years.^{1,3,6} A systematic review of 14 randomized clinical trials found that thyroid replacement therapy improves lipid profiles but does not result in decreased cardiac morbidity or mortality.¹⁵ Caraccio et al¹⁰ studied exercise tolerance in young adults and found the response to exercise as measured by maximal VO_2 was significantly reduced in patients with subclinical hypothyroidism and did not improve with hormone replacement therapy even after one year. The authors suggested that the neuromuscular deficits associated with hypothyroidism (as described above) may account for some of the reduced fitness observed in the subjects.

The integumentary system can also be negatively affected by low levels of thyroid hormones. Thyroid hormones impact dermal homeostasis and when

reduced the result is pale, dry, cool skin, and a thin epidermis that may limit that layer's protective function. The pale cool skin is the result of decreased skin perfusion. The dryness of hypothyroid skin is due to reduced activity of the eccrine glands, which are the major sweat glands of the body. Patients with low thyroid levels may exhibit slower wound and fracture healing; however, the research is not conclusive.¹⁶

Thyroid hormones also influence the human immune system and hematopoiesis in the bone marrow. The TSH has been shown to be produced and used by leukocytes or white blood cells that are essential components of the immune system. Thyroid stimulating hormone also enhances lymphocyte function and proliferation. Due to impaired immune response, patients with hypothyroidism may be at increased risk of tumor formation and some infectious diseases. A link between low thyroid hormone and decreased red blood cell production has also been found with hypothyroid patients being more susceptible to anemia. Individuals with leukopenia and/or anemia may have reduced tolerance to exercise and should be carefully monitored for adverse effects.¹⁷

Hypothyroidism has been associated with a number of neurological conditions such as depression, memory loss, and cognitive impairment. Thyroid hormones are vital for development and function of the brain. Neurogenesis in adults takes place in the dentate gyrus of the hippocampus and recent evidence has linked depression to the same. Thyroid hormone deficiency causes a reduction in the number of dentate gyrus cells and their migration and maturation. An animal study by Montero-Pedrazuela et al¹⁸ showed that short-term adult-onset hypothyroidism hinders neurogenesis and results in depression-like behaviors. Jackson¹⁹ found a link between deficiencies in the thyroid axis (hypothalamus, pituitary, and thyroid) and depression in adults. Miller et al²⁰ found that thyroid hormone deficiency caused significant limitations in verbal memory retrieval that appeared to be due to specific retrieval deficits rather than an attentional deficit. Dysfunction of the thyroid has also been linked to cognitive impairment and dementia.^{1-4,6,20} There is also a link between Alzheimer disease (AD) and thyroid function; however, the mechanism is not clear. Tan and Vasan²¹ studied the association of thyroid func-

tion to AD in older women and found that both high and low levels were associated with AD. They suggested that high levels of thyroid hormone might increase brain tissue oxidative stress while low levels might affect circulating levels of beta amyloid peptide (Abeta). The production and deposition of Abeta is strongly associated with the development of AD. Because of the link between thyroid dysfunction and AD, the American Association of Clinical Endocrinologists has proposed narrowing the target thyrotropin levels to 0.3 – 3.04 mIU/L with the hope that maintaining a narrower range might help prevent the development of AD in women.

Hypothyroidism is a common pathophysiological hormone deficiency. It can be congenital or acquired, primary or secondary, and range from mild to overt. It is much more common in women and the risk increases with age. In women age 60 years and more, subclinical hypothyroidism may be present in up to 20% and the overt condition in up to 5% of that population. Up to 8% of older men may have subclinical hypothyroidism.⁴ Because of the multisystem effects of hypothyroidism, physical therapists who work with geriatric patients and clients need to be aware of the signs, symptoms, and clinical manifestations of the condition. Older individuals presenting with otherwise undiagnosed symptoms such as fatigue, cold intolerance, joint and/or muscle pain, muscle weakness, bradycardia, hypotension, and cognitive decline should be referred for medical testing. In cases of diagnosed subclinical or overt hypothyroidism, physical therapists need to carefully monitor patient response to procedural interventions and make adjustments as indicated.

Physical therapy can assist in the management of some of the systemic manifestations of hypothyroidism. In older adults, exercise has been shown to improve cognition,²² muscle and cardiovascular function,²³ reduce lipid abnormalities,²⁴ and improve gastrointestinal motility.²⁵ Physical therapists may need to modify therapeutic exercise programs for older patients due to potential structural and chemical changes in skeletal muscle. Hypothyroidism effects on the cardiovascular system may reduce patient tolerance for exercise. Physical agents may be helpful to reduce joint and muscle pain; however, care should be taken when applying physical agents to or handling patients with hypothy-

roidism since thyroid deficient skin is more susceptible to burns, tears, breakdown, and slower healing. Physical therapists should be aware that older patients with thyroid dysfunction may present with signs of depression, memory loss, or other cognitive impairments. Methods of communication and teaching of those patients may need to be modified and referrals to appropriate health care providers may be indicated. Patients receiving thyroid hormone replacement therapy should be monitored for signs of hyperthyroidism such as restlessness, tremor, increased sweating, and dyspnea. Some studies have shown that postmenopausal women receiving thyroid replacement therapy have significantly decreased bone mineral density.²

As the population ages, physical therapists who work with older adults will likely treat more individuals with thyroid dysfunction. In patients with hyperthyroidism, therapists must be aware of potential cardiac complications and osteoporosis. Physical therapy may assist in improving the quality of life for patients with subclinical or overt hypothyroid. The therapeutic approach should be individualized based on patient goals, presence of signs and symptoms, and associated medical conditions.

REFERENCES

1. Legrys VA, Hartmann K, Walsh JF. The clinical consequences and diagnosis of hypothyroidism. *Clin Lab Sci.* 2004;71(4):203-208.
2. Schindler AE. Thyroid function and postmenopause. *Gynecol Endocrinol.* 2003;17:79-85.
3. Roberts CGP, Ladenson PW. Hypothyroidism. *The Lancet.* 2004;363:793-803.
4. Peeters RP. Thyroid hormones and aging. *Hormones.* 2008;7(1):28-35.
5. Evans KM, Smith J. Complicated hypothyroidism. *Clin Med.* 2007;7(4):419-420.
6. Fatourechi V. Subclinical hypothyroidism: an update for primary care physicians. *Mayo Clin Proc.* 2009;84(1):65-71.
7. Duyff RF, Van den Bosch J, Laman DM, Porter van Loon BJ, Linssen W. Neuromuscular findings in thyroid dysfunction: a prospective clinical and electrodiagnostic study. *J Neurol Neurosurg Psychiatry.* 2000;68:750-755.
8. Argov Z, Renshaw PF, Boden B, Winokur A, Bank WJ. Effects of thyroid hormones on skeletal

- muscle bioenergetics. *J Clin Invest.* 1988;81:1695-1701.
9. Roy RR, Zhong H, Hodgson JA, Grossman EJ, Edgerton VR. Effect of altered thyroid state on the in situ mechanical properties of adult cat soleus. *Cells Tissues Organs.* 2003;173:162-171.
10. Caraccio N, Natali A, Sironi A, et al. Muscle metabolism and exercise tolerance in subclinical hypothyroidism: a controlled trial of levothyroxine.
11. Diven DG, Gwinup G, Newton RC. The thyroid. *Dermatol Clin.* 1989;7:547-557.
12. Ciloglu F, Peker I, Pehlivan A, et al. Exercise intensity and its effects on thyroid hormones. *Neuroendocrinology Letters.* 2005;6(26):830-834.
13. Meena CL, Meena RD, Nawal R, Meena VK, Bharti A, Meena LP. Assessment of left ventricular diastolic dysfunction in sub-clinical hypothyroidism. *ACTA Inform Med.* 2012;20(4):218-220.
14. Galli E, Pingitore A, Iervasi G. The role of thyroid hormone in the pathophysiology of heart failure: clinical evidence. *Heart Fail Rev.* 2010;15:155-169.
15. Villar HC, Saconato H, Valente O, Atallah AN. Thyroid hormone replacement for subclinical hypothyroidism. *Cochrane Database Syst Rev.* 2007;(3):CS003419.
16. Safer JD. Thyroid hormone action on skin. *Dermatoendocrinol.* 2011;3(3): 211-215.
17. Jafarzadeh A, Poorgholami M, Izadi N, Nemati M, Rezayati M. Immunological and hematological changes in patients with hyperthyroidism and hypothyroidism. *Clin Invest Med.* 2010;33(5):E271-E279.
18. Montero-Pedrazuela A, Venero C, Lavado-Autric R, et al. Modulation of adult hippocampal neurogenesis by thyroid hormones: implication in depressive-like behavior. *Molec Psychiatry.* 2006;11:361-371.
19. Jackson JM. The thyroid axis and depression. *Thyroid.* 1998;9:951-956.
20. Miller KJ, Parsons TD, Whybrow PC, et al. Verbal memory retrieval deficits associated with untreated hypothyroidism. *J Neuropsychiatry Clin Neurosci.* 2007;19(2):132-136.
21. Tan ZS, Vasan RS. Thyroid function and Alzheimer's disease. *J Alzheimers Dis.* 2009;16(3):503-507.

(Continued on page 25)

OSTEOPOROSIS

Onkar J. Rajadhyaksha, PT, MHS; Jennifer M. Bottomley, PT, MS, PhD

Osteoporosis is a disorder of the skeleton characterized by decreased bone mineral density (BMD) that affects micro-architecture and strength of the bone.¹ The bone loses its strength and easily breaks in response to minor trauma. Current statistics show that there are about 10 million people in the United States (US) that have osteoporosis, and about 300,000 hip fractures and 700,000 vertebral fractures are a result of osteoporosis in the US.² Osteoporosis and resulting fractures affect physical and psycho-social well-being of an individual. This ultimately affects the quality of life (QOL) of the individuals. Medical costs associated with osteoporosis and resulting fractures are also enormous, ranging from \$10 to \$22 billion each year.² Therefore, it is necessary for a physical therapist to have knowledge about the screening, diagnosis, prevention, and treatment of osteoporosis. Also, it is necessary to know about various consequences of osteoporosis in the elderly population.

Researchers at the Mayo Clinic have classified osteoporosis into primary or secondary osteoporosis depending on its etiology.¹ Primary osteoporosis is due to the aging process.¹ Secondary osteoporosis is due to medical disorders like rheumatoid arthritis, nutritional deficiencies due to gastrointestinal diseases, and certain medications like an excess of glucocorticoids.^{1,3} So it becomes necessary for a physical therapist to identify the cause of osteoporosis so that managing the patient is easy. An elderly patient may be classified into primary osteoporosis. However, a secondary cause can also be present that can increase the medical complexity of the patient. Hence, presence of a secondary cause should also be explored and the patient should be referred accordingly.

Identifying causes and providing intervention for osteoporosis is possible once the patient presents with the condition or its associated symptoms. However, along with intervention, physical

therapists should also focus on preventive measures. Preventive measures are possible only when a therapist is able to identify any risk factor and appropriately screen patients who may develop osteoporosis. Various risk factors have been identified. Some of these risk factors^{1,3,4} are as follows:

1. All women over 65 years of age and men over 70 years of age.^{1,4}
2. All postmenopausal women with low body weight (less than 127 lbs), low BMI (less than or equal to 20), or a current smoker.¹
3. Men or women with prolonged immobilization, or on corticosteroid treatment.¹
4. Men or women with a history of vertebral fracture.¹
5. Secondary causes like gastrointestinal disorders, hematologic diseases, and hypogonadal states.³
6. Various behavioral factors like cigarette smoking, excess alcohol intake, low level of physical activity, and caffeine intake.³
7. Increasing age and different racial and ethnic groups also affect BMD levels. For example, African-American women have higher BMD than white non-Hispanic women, while white and Asian men have more BMD than women.³
8. Poor health, recent falls, impaired vision, dementia.¹
9. Men or women with solid organ or bone marrow transplants.¹

Based on these risk factors, patients should be screened for osteoporosis. A physical therapist should also be aware of these risk factors. As there is direct access in many states, a patient can directly come to a physical therapist. When evaluating the patient, if a physical therapist suspects that the patient may develop osteoporosis due to various risk factors, then the patient should be referred to a physician for further assessment. Another tool that is available to screen individuals with osteoporosis

is Simple Calculated Osteoporosis Risk Estimation (SCORE).⁵ The tool consists of 6 items and has got good sensitivity and specificity.⁶ The tool is used to identify whether postmenopausal women need to undergo BMD testing.⁶ Various other risk assessment tools can be used to screen individuals for risk of osteoporosis. Some of them are Osteoporosis Self-assessment Screening Tool (OST), Osteoporosis Risk-assessment Instrument (ORAI), and Osteoporosis Index of Risk (OSIRIS).⁴ Such tools can be used by physical therapist to screen their patients for risk of osteoporosis.

Further evaluation of patients after screening is usually done by measuring their BMD using dual-energy x-ray absorptiometry (DEXA) and quantitative computed tomography (QCT). DEXA is considered gold standard method for measuring BMD.³ Dual-energy x-ray absorptiometry measures BMD and represents it in the form of a T-score and Z-score. T-score measures BMD by comparing it with young healthy white women while Z-score measures BMD by comparing it with age and gender-matched controls.⁷ Both, T-score and Z-score are standard deviations measured above and below the average BMD value.⁷ Bone mineral density of 2.5 or more below the mean is indicative of osteoporosis and BMD between 1 and 2.5 standard deviations below the mean is indicative of osteopenia.⁸ The diagnosis of osteoporosis in men is different as the WHO's criteria is based on young healthy white women. Therefore, it cannot be used in diagnosing osteoporosis in men. However, a T-score in healthy men is available and it can be used to find BMD using DEXA.⁹ The American College of Physicians recommends that risk factors suggestive of osteoporosis should be evaluated in men prior to DEXA.¹⁰ Some of these factors are age above 70 years, body mass index (BMI) of less than 20 to 25, recent loss of weight of more than 10%, lack of physical activity, corticosteroid use, androgen

deprivation therapy, and previous fragility fracture.^{9,10} One study shows that men are more prone to develop osteoporosis due to secondary causes.⁹ Therefore, these causes need to be evaluated.

The DEXA is used to find BMD in both men and women. Low BMD values increase the risk of fractures. However, BMD alone cannot determine the risk of fracture. Other factors also play an important role. Considering the effect of various factors, risk of fractures can be calculated using the WHO fracture risk assessment tool called FRAX. The FRAX takes into account the effect of various risk factors like age, sex, height, weight, smoking, and other validated risk factors to calculate 10-year probability of hip fracture and a major osteoporotic fracture.⁹ For a physical therapist, it is important to have knowledge about WHO's criteria and fracture risk assessment tools. This will help a therapist to determine whether a patient is at a risk of developing an osteoporotic fracture. Accordingly, the therapist should take necessary precautions when providing therapeutic exercises. Also, the patient should be educated about the disease and various risk factors associated with it especially those that can be modified like cessation of smoking and increasing physical activity. In addition, the therapist should perform environmental assessments to remove all hazards that can lead to a potential fall. This is important in an elderly population that is at a higher risk of falls.

After diagnosing osteoporosis, treatment is started. As osteoporosis is due to combination of various factors, treatment should target these multiple factors. Primary osteoporosis is due to aging process. Multiple factors related to aging are responsible for decreased BMD. With aging, there is malabsorption of nutrients especially calcium and vitamin D that can lead to deficiency of calcium.¹¹ Aging is also associated with decreased physical activity due to changes in the cardiovascular system, pulmonary system, neuromuscular system, and musculoskeletal system.¹¹ Decreased physical activity leads to decreased BMD. Therefore, treatment for osteoporosis should target these multiple factors. Secondary osteoporosis is due to medical conditions. Therefore, the medical conditions need to be treated first. Then further treatment is targeted

towards improving BMD. Treatment of osteoporosis consists of a combination of medical care, nutrition, and rehabilitation. All the treatments are targeted at prevention of loss of bone mass.

Prevention is possible by the use of calcium and vitamin D. As aging is associated with decreased calcium and vitamin D levels in the body, calcium and vitamin D supplements should be started in elderly population.¹ Two studies have evaluated the effect of calcium and vitamin D supplements on BMD and risk of falls in elderly women. The first study was done on elderly women with a vitamin D deficiency.¹² It was found that vitamin D supplementation and calcium supplementation for one year improved BMD in elderly women.¹² The second study¹³ was a randomized control trial (RCT). One hundred twenty-two women were randomized into two groups to receive either calcium and vitamin D or calcium alone.¹³ It was found that calcium along with vitamin D supplements reduced the risk of falls by 49% as compared to calcium alone.¹³ Therefore, calcium and vitamin D supplements should be provided to the elderly population to prevent osteoporosis. The National Institute of Health recommends calcium intake for older adults to be between 1000-1500 mg per day and daily vitamin D intake of 400-600 IU per day.⁷ Therefore, a physical therapist should be aware whether the patient is taking any calcium or vitamin D supplements and the recommended dose.

Dietary intake of food that is rich in calcium and vitamin D is also indicated in the elderly population. One of the richest sources of calcium comes from dietary products like milk, yogurt, and cheese.¹ Along with dairy products, intake of fruits and vegetables should be increased while intake of calcium deficient beverages like sodas should be reduced.⁷ Along with calcium intake, vitamin D intake should also be increased as vitamin D is required for calcium absorption from the intestine. Vitamin D can be obtained from vitamin D-fortified milk, cereals, egg yolk, salt water fish, and liver.¹ In addition to dietary intake of vitamin D, adequate exposure to morning sunlight is also recommended to produce vitamin D in the body. Nguyen et al¹⁴ conducted a cross-sectional epidemiological study to evaluate association of BMD with BMI,

physical activity, quadriceps strength, and dietary calcium intake. Dietary calcium intake was measured using 4-day weighed food frequency questionnaire. The authors found a positive association of BMD dietary calcium intake. Thus adequate calcium and vitamin D is necessary in an elderly population suspected of osteoporosis. It is the responsibility of the therapist to refer the patient to a dietitian to increase dietary calcium and vitamin D intake.

In rehabilitation, preventive measures are directed at maintaining or increasing BMD. Prevention starts with education of the patient and the family about the disease process, its probable causes and consequences. Prevention also requires a change in lifestyle. One of the main causes of low BMD is a sedentary lifestyle. Pagonis et al¹⁵ conducted a retrospective double blinded study to find the differences between rural and metropolitan population with respect to osteoporosis. Six hundred ninety-seven osteoporotic patients from rural and metropolitan areas of Greece were included in the study. The authors¹⁵ found that individuals in rural areas developed osteoporosis at a later stage than individuals in metropolitan areas. Also, the fractures were numerous and severe in metropolitan population. The authors¹⁵ attributed these changes to a poor quality way of life and decreased activity levels in metropolitan areas. Therefore, it is necessary to increase activity levels in elderly individuals. One way to increase activity levels is through exercise. Two studies have evaluated the effect of exercises on BMD. Tolomio et al¹⁶ studied the effects of a specific exercise program consisting of strength, aerobic, balance, and joint mobility exercises on bone density, bone quality, and physical function capacity in postmenopausal women with low bone mineral density. Exercises were performed on land and water 3 times a week. The home exercise program was also included. After an 11-month exercise program, it was found that the specific exercise program improved physical function capacity, maintained bone quality, and reduced bone loss in postmenopausal women with low BMD. Another study is a Cochrane review.¹⁷ The review was conducted to study the effects of exercise in preventing bone loss and fractures in postmenopausal women. Forty-three randomized con-

trolled trials were included in the review. Exercise interventions were categorized into 6 categories¹⁷:

1. Static weight bearing exercises like single leg standing.
2. Low force dynamic weight bearing exercises like walking and Tai chi.
3. High force dynamic weight bearing exercises like jogging, jumping, running, dancing, and vibration platform.
4. Low force nonweight bearing exercises, eg, low load, high repetition strength training.
5. High force nonweight bearing exercises like progressive resisted strength training.
6. Combination consisting of more than one of the above exercise interventions.

The results of the review show that high force nonweight bearing exercises improve BMD at the neck of the femur while a combination of exercise interventions improves BMD at the spine.¹⁷ The authors concluded that although exercises have a small effect on BMD, it is a safe and effective way to reduce bone loss in postmenopausal women.¹⁷ Both the studies show that an exercise program consisting of combination of exercises is effective in maintaining BMD. Therefore, a plan of care should include various exercises and a proper home exercise program.

Another important aim of rehabilitation is prevention of falls. Most of the fractures that occur in elderly people with osteoporosis are because of a fall. Hence, a physical therapist should identify patients who are at increased risk of falls. Certain outcome measures can be used to assess fall risk. Two of the most widely used scales are Falls Efficacy Scale (FES) and Activities-specific Balance and Confidence Scale (ABC).¹⁸ Falls efficacy scale measures self-efficacy at avoiding a fall during basic activities of daily living (ADLs) while ABC measures balance confidence during ADLs.¹⁸ These scales can inform a therapist about the risk of fall. Then the therapist should further evaluate the patient to find the factors that can lead to a fall. These causes can be visual impairment, cognitive impairment, poor balance, poor strength in lower limbs, vestibular deficits, any medications and environmental hazards.¹ Chan et al¹⁹ performed

a prospective cohort study to examine the relation among physical activity, physical performance, and incidence of falls in 5,995 community-dwelling older men. The authors¹⁹ found that increased risk of falling was associated with more physical activity, lower leg power and grip strength, and slower narrow-walk pace. They also found that fall risk was more with household activities than with leisure activities. Therefore, a plan of care should include exercises to improve strength and balance in elderly people. Madureira et al²⁰ conducted a RCT to study the effect of a 12-month balance training program on balance, mobility, and falling frequency in elderly women with osteoporosis. They found that balance exercises for one hour each week, and 30 minutes of home exercises 3 times a week were effective in reducing risk of falls in elderly women with osteoporosis. Burke et al²¹ conducted a RCT to compare the effects of balance training associated with muscle strengthening or stretching in the postural control of elderly women with osteoporosis. Balance exercises were incorporated into strengthening and stretching exercises. Following an 8-week period of intervention, authors found that balance exercises along with strengthening or stretching program improved postural control in elderly women with osteoporosis. Along with proper exercises, environment modification is also necessary. These include minimizing clutter, providing supports like grab bars in bathtubs and toilet, improving lighting, and removing loose rugs to improve safety.^{1,5,22} Use of assistive devices like walkers and canes should be considered to improve balance.²² In addition, individuals with visual impairment, vestibular impairment, and cognitive impairment should be referred back to their physician. Certain medications like sedatives and psychoactive medications need to be reviewed by the physician.²²

Preventive measures are necessary in patients suspected of osteoporosis and those patients diagnosed with osteoporosis. However, patients diagnosed with osteoporosis should also receive additional treatment to correct bone loss. Bone loss due to osteoporosis produces many symptoms in these individuals. Some of these symptoms are back pain, stooped posture due to loss of vertebral height, pain in the extremities, fracture

of spine or hip, and respiratory impairment.²³ In osteoporosis, there is loss of bone mass. This leads to collapse of vertebral bodies. The most commonly affected region is the thoracic spine. As a result, there is anterior wedging of the thoracic bodies that increases kyphosis of the thoracic spine. This leads to stooping of posture and dowager's hump in some individuals.²³ It can also be the cause of back pain. Stooping of posture and dowager's hump affects respiration. As a result, endurance is affected. Individuals with vertebral or hip fractures require hospitalization. Immobility associated with hospitalization in elderly patients also has a negative effect on the health of these elderly individuals. As a result, they become physically limited. This affects their QOL. Treatment of these individuals consists of reduction of bone loss, improving strength and endurance, improving mobility, and ultimately their QOL. Their treatment can again be categorized into medical care, nutrition, and rehabilitation.

Medical care consists of use of pharmacological treatments like hormone therapy, bisphosphonates, raloxifene, calcitonin, teriparatide, and combination therapy.¹ Hormone therapy has been found to decrease bone loss.⁵ However, due to adverse events like stroke, breast cancer, venous thrombo-embolism, and coronary heart disease, it is used in small doses in selected postmenopausal women.^{1,5} Bisphosphonates like alendronate, risedronate, ibandronate reduces bone loss by decreasing osteoclastic activity.^{1,5} They have also been found to reduce vertebral fractures. Reginster et al²⁴ conducted a RCT to determine the efficacy and safety of risedronate in the prevention of vertebral fractures in postmenopausal women with established osteoporosis. The authors found that 5 mg of risedronate reduced the incidence of new vertebral fractures over a period of 3 years. It was also found that risedronate improved BMD at the lumbar spine in these women. Alendronate is another bisphosphonate that is also used to improve BMD. According to one study,²⁵ alendronate improved BMD of lumbar spine, femoral neck, and the total hip in postmenopausal women with osteoporosis. Bisphosphonates have also been found to improve BMD in secondary osteoporosis. Two studies show the effectiveness of iban-

dronate in individuals with low BMD due to secondary causes.^{26,27} Hakala et al²⁶ conducted a RCT that showed the efficacy of oral ibandronate in improving BMD in lumbar spine and total hip in postmenopausal women on glucocorticoids treatment for inflammatory rheumatic diseases. Another study found ibandronate to be effective in improving BMD in patients with osteoporosis and osteopenia following liver transplantation surgery.²⁷ Another medication that is effective in osteoporosis is raloxifene. It is a selective estrogen receptor modulator. It has an estrogen-like effect on bone, and it helps in maintaining bone density.^{1,5} It is also found to be effective in preventing vertebral fractures.²⁸ Calcitonin is another medication that is used in the form of a nasal spray to treat osteoporosis.^{1,5} It inhibits osteoclastic activity, thus preventing bone loss. Teriparatide is a recombinant human parathyroid hormone. It has an anabolic effect on the bone. It improves BMD by increasing bone formation.^{1,5} All these medications when used alone have been found to improve BMD in elderly people with osteoporosis. However, when these medications are used in combination, they produce an additive effect on BMD.^{1,5} A RCT²⁵ was conducted to study the effects of raloxifene and alendronate on BMD in women with osteoporosis. The participants were divided into 3 groups. Two groups received either raloxifene or alendronate. The third group received a combination of both medications. It was found that BMD improved in all the groups. However, the authors found the effect to be better in combination group.²⁵ In addition to these medications; testosterone is used to improve BMD in older men.⁹ A physical therapist should have knowledge about these medications and adverse events associated with them. If a patient is not on medications, then he should be referred to his physician. The patients should also be educated about the need of these medications.

Nutrition and most of the rehabilitation measures used in the prevention of osteoporosis should be used in patients diagnosed with osteoporosis. All patients diagnosed with osteoporosis should receive a diet that provides sufficient calcium and vitamin D.¹ In addition, other vitamins and minerals should also be included in the diet. Therefore, their

diet should consist of dairy products, fruits and vegetables, cereals, salt water fish, and liver.¹ Similar to nutrition, preventive measures used in rehabilitation should also be used in patients diagnosed with osteoporosis. Along with improving BMD, another aim of rehabilitation is to address the symptoms associated with bone loss. Bone loss due to osteoporosis leads to anterior wedging of vertebra in the thoracic spine. As a result, there is thoracic kyphosis. Thoracic kyphosis can also be seen if the patient has sustained compression fracture of thoracic spine. Increased kyphosis may be associated with pain and reduced vital capacity. Physical therapy interventions should be directed at reducing kyphosis and improving respiratory capacity. Back extensor strengthening exercises have been found to reduce thoracic kyphosis and vertebral fractures that occur due to osteoporosis and aging.²⁹ Manual mobilization can be used to improve mobility in thoracic spine. Bautmans et al³⁰ studied the effects of rehabilitation program on thoracic spine kyphosis, back pain, and quality of life in elderly female patients with osteoporosis. The rehabilitation program consisted of manual mobilization, taping, and exercises for a period of 3 months. It was found that rehabilitation programs improved thoracic spine kyphosis. Therefore, a physical therapist can use manual mobilization to improve mobility in the spine. However, mobilization should be used with care in elderly patients with severe osteoporosis and those with vertebral fractures. Improving mobility and strength of the spine can improve stoop posture.³¹

Exercises done in a clinical setting are not enough. All elderly individuals should also be given an appropriate home exercise program (HEP) to maintain their trunk mobility and strength. Chien et al³² conducted a pilot study to test whether a home-based trunk-strengthening program would improve trunk mobility, decrease functional impairment, and improve QOL in postmenopausal women. All participants were given a detailed description of exercises consisting of various trunk exercises. After a 12-week period of intervention, spinal ROM and QOL showed improvement in postmenopausal women. It was also found that simple home-based trunk exercises were easy to follow and acceptable to postmenopausal

women with osteoporosis.³² Improvement in mobility, posture, strength, and function brings about improvement in QOL of elderly people. Quality of life of individuals with osteoporosis can be assessed using specific questionnaires. Some of these questionnaires are Osteoporosis Quality of Life Questionnaires (OQLQ), Osteoporosis Functional Disability Questionnaire (OFDQ), Quality of Life Questionnaire of the European Foundation for Osteoporosis (QUALEFFO), 41-item QUALEFFO and 31-item QUALEFFO.³³ These questionnaires can be used to assess the effect of an intervention on QOL in individuals with osteoporosis.³³ Bergland et al³⁴ conducted a RCT to study the effect of exercise and coping strategies for osteoporosis on mobility, balance, and quality of life in women with osteoporosis and history of vertebral fracture. In this study, QUALEFFO-41 was used to assess QOL. The intervention period consisted of various balance exercises, postural exercises, and trunk and chest exercises. This was followed by a lesson on coping strategies for osteoporosis. After 3 months of intervention, authors found that QOL of the participant improved. This improvement was also seen after a one year of follow-up period. All these studies²⁹⁻³⁴ show that exercises are important in patients with osteoporosis. Therefore, a physical therapist should make use of a combination of exercises in elderly patients with osteoporosis. The exercises should consist of breathing exercises, mobility exercises, and strength training and endurance exercises. Use of mobilization should also be considered after careful evaluation. To improve the carry-over effect of these exercises, all patients should be given an appropriate HEP. In this way, a physical therapist can improve the QOL of elderly individuals with osteoporosis.

Exercises are necessary to improve back strength. But individuals who are weak and frail may need additional help in maintaining their posture. In such cases, an appropriate orthosis can be used. Thoraco-lumbar orthoses can be used to maintain stabilization in individuals with or without vertebral fractures.²⁹ Pfeifer et al³⁵ conducted a randomized study to determine the efficacy of a newly developed spinal orthosis on posture, trunk strength, and QOL in postmenopausal women with

osteoporosis. Following 6 months of orthosis use, it was found that posture, trunk muscle strength, and QOL was improved. Although orthosis can be useful in improving posture, they cannot be considered as a substitute for exercise and rehabilitation.

Osteoporosis is a skeletal disorder leading to poor posture, limiting mobility, and functional impairment. This coupled with other diseases in the elderly population affects their QOL. A physical therapist should be aware that treatment of osteoporosis is a multidisciplinary approach. The patient, his family, the physician, the medical team, and the rehabilitation team should work together to help the patient. Treatment of osteoporosis requires a combination of medications, nutrition, and exercises. Exercises can be effective only if patient is on medications and receives proper nutrition. A single approach is not effective. Therapy should start with educating the patient about the disease process and its consequences. Following education, preventive measures should be used. This includes fall prevention and environmental assessment to remove the hazards that can lead to a fall. Exercises should include various types of exercise to improve range of motion, strength, mobility, and endurance. In addition to exercises, patients should be given a HEP to carry-over the effects of exercise. In this way, a physical therapist can improve function and QOL of elderly individuals with osteoporosis.

REFERENCES

1. Mauck K, Clarke B. Diagnosis, screening, prevention, and treatment of osteoporosis. *Mayo Clinic Proceedings*. 2006;81(5):662-672.
2. Blume S, Curtis J. Medical costs of osteoporosis in the elderly Medicare population. *Osteoporosis* 2011;22(6):1835-1844.
3. Lane N. Epidemiology, etiology, and diagnosis of osteoporosis. *Am J Obstet Gynecol*. 2006;194(2 Suppl):S3-S11.
4. Lim L, Hoeksema L, Sherin K. Screening for osteoporosis in the adult U.S. population: ACPM position statement on preventive practice. *Am J Prev Med*. 2009;36(4):366-375.
5. Sweet M, Sweet J, Jeremiah M, Galazka S. Diagnosis and treatment of osteoporosis. *Am Fam Physician*. 2009;79(3):193-200.
6. S.C.O.R.E. Clinical calculators. *OsteoEd*. University of Washington Website. <http://depts.washington.edu/osteoad/tools.php?type=score>. Accessed on March 25, 2013.
7. Osteoporosis prevention, diagnosis, and therapy. *NIH Consensus Statement*. March 27, 2000;17(1):1-45.
8. WHO scientific group on the assessment of osteoporosis at primary health care level: summary meeting report. *World Health Organization*. May 2004. Belgium. <http://www.who.int/chp/topics/Osteoporosis.pdf>. Accessed on March 25, 2013.
9. Adler R. Osteoporosis in men: insights for the clinician. *Ther Adv Musculoskelet Dis*. 2011;3(4):191-200.
10. Qaseem A, Snow V, Shekelle P, Hopkins R Jr, Forciea MA, Owens D. Screening for osteoporosis in men: A clinical practice guideline from the American College of Physicians. *Ann Intern Med*. 2008;148(9):680-684.
11. Lewis CB, Bottomley JM. *Geriatric Rehabilitation: A Clinical Approach* [CD-ROM]. 3rd ed. Upper Saddle River, NJ: Pearson Education; 2008.
12. Grados F, Brazier M, Kamel S, et al. Effects on bone mineral density of calcium and vitamin D supplementation in elderly women with vitamin D deficiency. *Joint Bone Spine*. 2003;70(3):203-208.
13. Bischoff H, Stahelin H, Dick W, et al. Effects of vitamin D and calcium supplementation on falls: a randomized controlled trial. *J Bone Miner Res*. 2003;18(2):343-351.
14. Nguyen T, Center J, Eisman J. Osteoporosis in elderly men and women: effects of dietary calcium, physical activity, and body mass index. *J Bone Miner Res*. 2000;15(2):322-331.
15. Pagonis T, Givissis P, Pagonis A, Petasatodis G, Christodoulou A. Osteoporosis onset differences between rural and metropolitan populations: correlation to fracture type, severity, and treatment efficacy. *J Bone Miner Metab*. 2012;30(1):85-92.
16. Tolomio S, Ermolao A, Lalli A, Zaccaria M. The effect of a multi-component dual-modality exercise program targeting osteoporosis on bone health status and physical function capacity of postmenopausal women. *J Women Aging*. 2010;22(4):241-254.
17. Shea B, Bonaiuti D, Cranney A, et al. Cochrane review on exercise for preventing and treating osteoporosis in postmenopausal women. *Eura Medicophys*. 2004;40(3):199-209.
18. Scheffer A, Schuurmans M, van Dijk N, T, de Rooij S. Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. *Age Ageing*. 2008;37(1):19-24.
19. Chan B, Marshall L, Winters K, Faulkner K, Schwartz A, Orwoll E. Incident fall risk and physical activity and physical performance among older men: the Osteoporotic Fractures in Men Study. *Am J Epidemiol*. 2007;165(6):696-703.
20. Madureira M, Takayama L, Gallinaro A, Caparbo V, Costa R, Pereira R. Balance training program is highly effective in improving functional status and reducing the risk of falls in elderly women with osteoporosis: a randomized controlled trial. *Osteoporos Int*. 2007;18(4):419-425.
21. Burke T, França F, Meneses S, Pereira R, Marques A. Postural control in elderly women with osteoporosis: comparison of balance, strengthening and stretching exercises. A randomized controlled trial. *Clin Rehabil*. 2012;26(11):1021-1031.
22. Lin J, Lane J. Nonpharmacologic management of osteoporosis to minimize fracture risk. *Nat Clin Pract Rheumatol*. 2008;4(1):20-25.
23. Li S, He H, Ding M, He C. The correlation of osteoporosis to clinical features: a study of 4382 female cases of a hospital cohort with musculoskeletal symptoms in southwest China. *BMC Musculoskelet Disord*. 2010;11:183.
24. Reginster J, Minne H, Eastell R, et al. Randomized trial of the effects of risedronate on vertebral fractures in women with established postmenopausal osteoporosis. Vertebral Efficacy with Risedronate Therapy (VERT) Study Group. *Osteoporos Int*. 2000;11(1):83-91.
25. Sanad Z, Ellakwa H, Desouky B. Comparison of alendronate and raloxifene in postmenopausal women with osteoporosis. *Climacteric*. 2011;14(3):369-377.
26. Hakala M, Kröger H, Paimela L, et al. Once-monthly oral ibandronate provides significant improvement in bone mineral density in post-

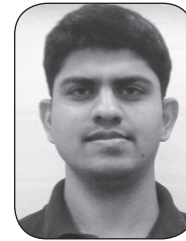
menopausal women treated with glucocorticoids for inflammatory rheumatic diseases: a 12-month, randomized, double-blind, placebo-controlled trial. *Scand J Rheumatol*. 2012;41(4):260-266.

27. Kaemmerer D, Schmidt B, Lehmann G, Wolf G, Hommann M, Sett-macher U. Monthly ibandronate for the prevention of bone loss in patients after liver transplantation. *Transplant Proc*. 2012;44(5):1362-1367.
28. MacLean C, Newberry S, Grossman J, et al. Systematic review: comparative effectiveness of treatments to prevent fractures in men and women with low bone density or osteoporosis. *Ann Intern Med*. 2008;148(3):197-213.
29. Pfeifer M, Sinaki M, Geusens P, Boonen S, Preisinger E, Minne H. Musculoskeletal rehabilitation in osteoporosis: a review. *J Bone Miner Res*. 2004;19(8):1208-1214.
30. Bautmans I, Van Arken J, Van Mackelenberg M, Mets T. Rehabilitation using manual mobilization for thoracic kyphosis in elderly postmeno-

pausal patients with osteoporosis. *J Rehabil Med*. 2010;42(2):129-135.

31. Standing tall. Exercises can help with the bad posture and osteoporosis that cause us to stoop and lose height as we get older. *Harv Health Lett*. 2005;31(2):1-3.
32. Chien M, Yang R, Tsao J. Home-based trunk-strengthening exercise for osteoporotic and osteopenic postmenopausal women without fracture--a pilot study. *Clin Rehabil*. 2005;19(1):28-36.
33. Madureira M, Ciconelli R, Pereira R. Quality of life measurements in patients with osteoporosis and fractures. *Clinics (São Paulo)*. 2012;67(11):1315-1320.
34. Bergland A, Thorsen H, Kåresen R. Effect of exercise on mobility, balance, and health-related quality of life in osteoporotic women with a history of vertebral fracture: a randomized, controlled trial. *Osteoporos Int*. 2011;22(6):1863-1871.
35. Pfeifer M, Begerow B, Minne H. Effects of a new spinal orthosis on posture, trunk strength, and quality of life in women with postmeno-

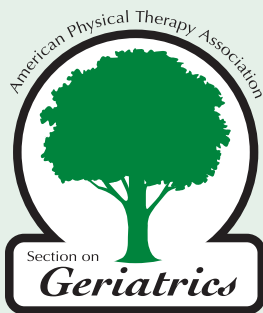
pausal osteoporosis: a randomized trial. *Am J Phys Med Rehabil*. 2004;83(3):177-186.



Onkar J. Rajadhyaksha has a Bachelors in Physical Therapy (B.P.Th) from Topiwala National Medical College, India and a Masters in Health Science from the University of Indianapolis. She is currently working as a PT in a SNF facility in Greensburg, IN.



Jennifer M. Bottomley is an independent consultant in geriatric rehabilitation, an educator, and has authored numerous articles, chapters, and texts. She currently serves on an Interdisciplinary Medicare Advisory Board for the White House, assisting in recommendations towards Health Care Reform.



Who Should Attend?

- Physical Therapists
- Physical Therapist Assistants
- Students in their final year of school in these fields

Register Now!

To download a registration form visit
www.geriaticsppt.org

Section on Geriatrics, APTA Presents:

Manual Physical Therapy for the Geriatric Patient

-15 Contact Hours-

May 31 - June 1, 2014

Truman Medical Center - Kansas City, MO

Presented by **Carleen Lindsey, PT, MScAH, GCS, CEEAA**

Description: This course is designed to give experienced PTs a practical approach to manual therapy interventions for the geriatric patient. Lab sessions and demonstrations will feature flexible curve kypholordosis measurement, muscle energy techniques for spinal, rib, and SIJ dysfunctions, joint mobilization for shoulder, hip, foot and ankle, myofascial and tender point releases, PNF with deep tissue mobilization, manual therapy with contract-relax and passive physiological intervertebral mobilization. This clinically comprehensive, hands-on workshop is designed for the PT to immediately apply the information in the clinical setting to geriatric patients.

	Register on or Before 4/30	Register After 4/30
Section on Geriatrics Member	\$315	\$365
APTA Member	\$375	\$425
Non-Member	\$435	\$485

3510 E. Washington Avenue | Madison, WI 53704 | P: 866/586-8247 | F: 608/221-9697

CASE REPORT FOR FM

A 95-YEAR-OLD MALE WITH PRIMARY TRANSTIBIAL AMPUTATION: AVOIDING AGEISM

Kenneth L. Miller, PT, DPT, CEEAA; Matt Flynn, CP, FAAOP

INTRODUCTION

Limb loss in the United States is a significant health care concern in terms of patient mortality and morbidity and associated financial cost.¹ Jindeel and Narahara¹ reported that the average length of stay (LOS) was more than double for nontraumatic lower extremity amputation (LEA) than for all other admissions with an estimated cost of 47 million at Harbor-UCLA Medical Center alone.¹ Even with the longer LOS and greater cost than for other admissions, the one- and 5-year mortality rates of 9.1% and 25.6% respectively are high.¹ The average age for diabetes-related amputation was 66 years and for nondiabetes-related amputation was 71 years.² Among diabetics, the amputation rate increases with age from 3.9 per 1000 people with diabetes among people under age 65 to 6.6 per 1000 people with diabetes among people 65-74 and 7.9 per 1000 people with diabetes among people 75 or older.² The age adjusted LEA rate was 28 times that of people without diabetes (5.5 per 1000 people with diabetes vs. 0.2 per 1000 people without diabetes).² The subject in this case study is a 95-year-old male that underwent a primary transtibial amputation on January 13, 2013, due to cellulitis and gangrene in LLE with peripheral vascular disease (PVD). The patient did not have diabetes. Past medical history included chronic obstructive pulmonary disease (COPD), benign prostatic hyperplasia (BPH), and hypothyroidism.

The vascular surgeon treating FM offered the option of bypass surgery, however, due to low chance of successful bypass surgery, the patient and his family elected to have the amputation to avoid a probable more lengthy hospital stay and risk for multiple salvage procedures. Prior to surgery the patient lived with his spouse in a private home with intermittent assistance from family. FM was the primary caregiver of his wife. Prior level of function: subject was able to walk 3 blocks until one week prior

to surgery that supported the opinion that the patient had good potential to ambulate with a prosthesis. He was determined to be a K1 ambulator with the ability to transfer and/or ambulate on level surfaces at fixed cadence. The patient was hospitalized for 14 days in the acute hospital before being transferred to the subacute rehab facility for 71 days.

REHABILITATION COURSE

At two weeks post-transtibial amputation surgery, the Skilled Nursing Facility began ace wrapping to control swelling and began shaping the residual limb as preparation for the prosthesis. The challenge of fitting a prosthesis early in the rehabilitation course is deciding when to create the socket as the limb volume fluctuates widely. However, the challenges of early fitting are far outweighed by the benefits of early fitting.

On 2/26/13, the patient was 6 weeks post-op with sutures in place, dry, intact and healed suture line. He was casted using a thin cast sock over the skin and 3 mm locking silicone liner. The limb was only slightly bulbous and the use of tension from the liner flattened the tissue to become cylindrical. The cast removed with ease and the patient tolerated the procedure well. A stump shrinker was introduced at that time. At this time, the physical examination revealed good strength (4/5) in bilateral upper extremities, bilateral hips in all planes of motion, and in bilateral knee flexors/extensors. FM did not have any functional limitations due to range of motion (ROM) in any extremities. FM had full knee extension and was able to extend his hips beyond neutral. There were no ROM limitations of the sound ankle; however, he had a heel ulcer from 10 years past and was slightly sensitive. His sensation was intact to light touch throughout bilateral lower extremities.

On 2/28/2013, the patient was fitted with a diagnostic clear socket for optimal fit. He was fit over a 3mm locking liner, the fit was snug at that time and it was decided to finish the

prosthesis. The plan for prosthesis fabrication and fitting was to fabricate the first prosthesis as early as healing would allow for early weight bearing which prevents disuse atrophy and promotes psychosocial adaptation and rehabilitation of the amputee.³ Additionally, immobilization affects neuronal motor function and an attenuated response to retraining in the older population.⁴

On 3/11/2013, the patient was fit with his first prosthesis. The prosthetic design consisted of an endoskeletal design including "SACH" foot, total contact socket, flexible inner socket with rigid frame, alignable components, a locking mechanism, and suspension sleeve to reduce pin pressure from early use, lightweight carbon lamination, and 3 mm locking liners. This would be increased to 6 mm if the limb reduced beyond the use of stump socks and a soft outer cover completes the prosthesis. Height and alignment were accomplished successfully due to the alignable components. The patient donned a thin one-ply cotton sock on the skin to reduce traction from the locking liner; the family was instructed to use this for only a week. The 3 mm liner was rolled on and both pin and suspension sleeve were used for suspension. The limb is still healing and use of a sleeve will reduce pin pressure. The patient was able to stand using a fixed walker and began a step to gait pattern. The patient was instructed to begin wearing the prosthesis daily for one hour in the morning and one hour in the afternoon. Within a 3-week period the patient was wearing his prosthesis for 6 hours daily and the increased sock thickness increased to 3-ply as limb volume decreased.

The patient was treated in subacute rehabilitation for prosthetic training using a walker and was discharged on 4/26/13. Home care service started the following day including: nursing, physical therapy, occupational therapy, social work, and home health aide services. The patient's home care diagnoses in-

cluded COPD, BPH (Foley catheter in place), below knee amputation, muscles weakness-general, abnormality of gait, acute URI, and urine retention. The home care physical therapy evaluation revealed that the patient did not have any complaints of pain or phantom sensation, ROM was full for knee extension LLE, strength of RLE = 4-/5 for knee extension and LLE = 3+/5 for knee extension. The patient was independent with bed mobility, required minimum assistance with sit-to-stand transfers and minimum assistance with ambulation using L below knee prosthesis and rolling walker short distances of 30 feet. On reassessment 2 weeks later, the patients strength has improved in RLE to 4/5 and patient was able to transfer self with supervision and perform the 30 second chair stand test⁵ using his arms and performed 5 repetitions and reported having an rate of perceived exertion score⁶ of 7/10 indicating that the sit to stand activity was requiring more than moderate effort. Upon discharge from PT 4 weeks later, the patient's strength has improved to 4+/5, transfers were independent, Timed Up and Go score⁷ was 42 seconds improved from being unable upon evaluation. Patient was ambulating 75 feet x 3 with prosthesis and rolling walker independently and he was able to negotiate one step with contact guard.

CONCLUSION

FM, the subject in this case report, was a 95-year-old male when he underwent primary amputation surgery. The outcomes achieved for this subject may not have been possible if not for the fact

that the clinicians involved in FM's care did not give into ageism and handicap his potential for improvement by providing him a lesser level of rehabilitative care. Additionally, with early prosthetic fitting the patient was able to maximize his rehabilitative potential. Psychosocial adaptation was maximized and disuse atrophy was minimized as were the negative effects of immobilization on neuronal motor function and an attenuated response to retraining due to early fitting and weight bearing.

REFERENCES

1. Jindeel A, Narahara KA. Non-traumatic amputation: incidence and cost analysis. *Int J Low Extrem Wounds*. 2012;11:177-179.
2. National Limb Loss Amputation Center. 2008. http://www.amputee-coalition.org/fact_sheets/diabetes_le-amp.html#. Accessed July 21, 2013.
3. Kraker D, Pinzur MS, Daley R, Osterman, H. Early post-surgical prosthetic fitting with a pre-fabricated plastic limb. *Orthopedics*. 1986;9(7):989-992.
4. Suetta C, Hvid IG, Justesen L, et al. Effects of aging on human skeletal muscle after immobilization and retraining. *Arch Gerontol Geriatr*. 2012;54(2):374-380.
5. Jones CJ, Rikli RE. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exerc Sport*. 1999; 70(2):113-119.
6. Borg G. Perceived exertion as an indicator of somatic stress. *Scand J Rehabil Med*. 1970;2(2):92-98.

7. Shumway-Cook A, Brauer S, Wool-lacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Phys Ther*. 2000;80(9):896-903.



Dr Miller is a nationally known speaker and educator providing professional development for therapy provision using an interdisciplinary approach for care coordination

to maximize outcomes and standardize practice. He serves on the Practice Committee for the Section on Geriatrics and is the Chair of the Practice Committee for the Home Health Section where he is involved in the development of best practice resources. Dr Miller may be reached at kenmpt@aol.com.



Matt Flynn is a practicing prosthetist for over 32 years at New York Presbyterian Hospital. He works closely with vascular and orthopedic surgeons which has afforded him an inter-

disciplinary experience to improve prosthetic fabrication, fitting, and patient experience. He may be reached at mflynn2@optonline.net.

(Continued from page 17)

22. Langlois F, Vu TT, Chasse K, et al. Benefits of physical exercise training on cognition and quality of life in frail older adults. *J Gerontol B Psychol Sci Soc Sci*. 2012 Aug 28. [Epub ahead of print]. <http://www.ncbi.nlm.nih.gov/pubmed/22929394>. Accessed March 22, 2013.
23. Mazzeo RS. Exercise and the older adult. *ACSM Current Comment*. <http://www.acsm.org/docs/current-comments/exerciseandtheolderadult.pdf>. Accessed March 22, 2013.
24. Boardley D, Fahlman M, Topp R, Morgan AL, McNeven N. The impact of exercise training on blood lipids in older adults. *Am J Geriatr Cardiol*. 2007;16(1):30-5.

25. Hsieh C. Treatment of constipation in older adults. *Am Fam Physician*. 2005;72(11):2277-2284.



Debra Gray is the Manager of the Flex DPT programs at the University of St Augustine for Health Sciences. She received her Bachelor of Science degree in Physical Therapy

from Wayne State University, a Master of Education degree from the University of Wisconsin, a Doctor of Physical Therapy degree from Simmons College and a Doctor of Health Science degree

from the University of Indianapolis. Her clinical practice includes home care, outpatient, and community based wellness programs for the geriatric population.

Jennifer M. Bottomley is an independent consultant in geriatric rehabilitation, an educator, and has authored numerous articles, chapters, and texts. She currently serves on an Interdisciplinary Medicare Advisory Board for the White House, assisting in recommendations towards Health Care Reform.



MAYO CLINIC ANNOUNCES PHYSICAL THERAPY GERIATRIC RESIDENCY IN ARIZONA

Kathryn Brewer, PT, GCS, MEd, CEEAA



At Mayo Clinic, the education shield is considered one of the most important investments to sustain our patient care mission today and into our future. This commitment may seem distant from the inherent primary focus on the patient, yet it truly brings excellence and quality to our patient care. The 5 schools within the Mayo Clinic College of Medicine offer multiple training programs that create an environment that fosters the highest quality of patient care by discovering and teaching tomorrow's medicine to health care and biomedical research professionals through life-long learning, and in a team-based environment. Learning opportunities in advanced specialty practices across a variety of clinical settings throughout the Mayo Clinic system demonstrate Mayo's commitment to clinical excellence and contribution to preparing health care providers for the future.

The mission of the Mayo School of Health Sciences Physical Therapy Geriatric Residency is to provide a planned program of postprofessional clinical and didactic education that is designed to significantly advance the physical therapist's preparation as a provider and advocate of services for geriatric clients.

Advanced clinical training and professional development is mentored by Mayo Clinic faculty and staff with demonstrated expertise and experience that exemplify the core values of physical therapy professionalism and patient care. Training of residents in this defined specialty area will prepare them for board certification examination. The resident will contribute to the field of geriatric physical therapy through knowledge, practice, and education. This develops an emerging clinical leader and advocate in geriatric care.

PROGRAM OVERVIEW

The American Board of Physical Therapy Residency and Fellowship Education (ABPTRFE) has credentialed the

Geriatric Residency Program effective 10/31/13.

2014-15 Calendar:

Admissions open	1/1/14
Application deadline	2/28/14
Admission decision date	4/15/14
Program Start Date	7/01/14
Program End Date	6/26/15

The program profile is available on RFPPTCAS: www.abptrfe.org/rfpptcas

For supplemental application materials – see www.mayo.edu/mshs/careers/physical-therapy/physical-therapy-geriatric-residency-arizona/application-process

Providing and advocating for the geriatric client is the central focus of the residency program. All of the goals and objectives are designed to best prepare the resident to provide this optimal care. All aspects of advanced clinical proficiency are designed to enhance and improve patient centered care through didactic education, development of clinical skills and experience, and promotion of professionalism in practice. The curriculum is delivered completely within the Mayo Clinic organization.

The course of study and clinical experience is designed in a logical manner so that the resident flows through a variety of patient care settings while the didactic components serve to support the specific clinical areas in which the resident will be practicing. Each didactic component is described in scope related to care of the older adult. Course objectives, instruction methods, readings, and resource links are all planned and clearly stated. All primary instructors hold academic rank in the Mayo Clinic College of Medicine. Collaboration from physician and other allied health care providers are included in the presentation of course materials. Methodology includes lecture, lab, observation of medical and surgical interventions, participation with patient and patient groups representing the variety of pathologies and conditions presented by geriatric patients. BlackBoard is being used as the platform

for communication and resources for the didactic curriculum.

Clinical skills training will occur daily as the resident engages in practice across the Mayo Clinic continuum of therapy services. Weekly sessions with board certified mentors will allow investigation of evaluation, diagnosis, prognosis, treatment planning, and intervention strategies on an individual level for depth and clarity. Clinical reasoning, self-reflection, and evidence-based practice will be emphasized. The resident-mentor interaction is collaborative and collegial, underscoring two way communications and providing opportunity to expand capacity and competence.

Professionalism will be stressed throughout the curriculum and resident experience. This will occur through role modeling of faculty and peer staff as well as opportunities to participate in a diverse practice environment. Regulatory issues will be addressed across practice settings as patient management strategies must meet variable criteria while accomplishing optimal clinical outcomes. Ethics and values will be taught didactically as well as emphasized in all resident-patient interaction. Interdisciplinary teams consisting of a variety of allied health and physician specialties deliver team-based, patient-centered care. The Mayo professional network extends across the enterprise to campuses in Rochester MN and Jacksonville FL.

The resident is expected to be sufficiently prepared clinically, academically, and professionally to successfully achieve board certification at the conclusion of this program. At this time, we welcome inquiries and applications for the 2014-15 curriculum year.

PROGRAM HIGHLIGHTS:

- Program length: 12 months/full time.
- One resident accepted per curriculum year
- Stipend w/ benefits, no tuition. Attendance to one national conference.
- 70% patient care (geriatric caseload) – requires monthly weekend rotation

(Continued on page 27)

CERTIFIED EXERCISE EXPERTS FOR AGING ADULTS

CONGRATULATIONS GRADUATES!

Danille Parker, PT, DPT, GCS, CEEAA

The SOG Certified Experts for Aging Adults (CEEAA) program, co-chaired by Marilyn Moffat, PT, DPT, PhD, GCS, CSCS, CEEAA, FAPTA, and Karen Kemmis, PT, DPT, MS, GCS, CDE, CPRP, CEEAA, continues to be a huge success. Since 2009, over 700 therapists have successfully completed the 3-course series, including the written and practical examinations to proudly use CEEAA after their name. The SOG would like to congratulate the following individuals who have completed the CEEAA series in 2013.

Therapists with the CEEAA credential demonstrate expert clinical decision-making skills in: examining the aging adult in multiple areas; designing and applying efficient and effective exercise prescriptions; and using the best evidence for exercise interventions for all aging adults. Some of the top reasons, as stated by graduates, to obtain your CEEAA certification are to:

- Learn, practice, and utilize tests and measures with strong psychometric properties that scientifically measure outcomes in the areas of aerobic capacity, anthropometric characteristics, attention and cognition, gait and locomotion, balance, motor function, muscle performance, posture, range of motion, sensory integrity, and vestibular function.
- Expand your understanding of, frequency, intensity, time, and type for exercise prescription based on science so that you know how to challenge your patients/clients to preclude them from sliding down the slippery slope of aging.
- Learn how to determine appropriate and safe intensity for all categories of exercise for your patients/clients regardless of diagnosis and practice setting.
- Practice and learn how to teach hundreds of different aerobic con-

ditioning/endurance, balance, body mechanics and postural stabilization, flexibility, gait and locomotion, and muscle performance training exercises that can be modified for any aging adult.

- Have the latest evidence for how and why exercise helps with many conditions, including: cancer, cardiovascular, endocrine, musculoskeletal, neuromuscular, cognitive, obesity, pulmonary, and renal diseases, disorders, and conditions.
- Have the knowledge and the assurance that physical therapists are the professionals who are the key in improving the health and fitness of our aging population.

Still considering taking the CEEAA course series? See what your PT peers are saying about the CEEAA courses to help you decide:

- “This is by far the most beneficial course series of my professional career. Everything is applicable and relevant and so clinically oriented. I was able to return to the clinic and apply the information immediately.”
- “Best Con-Ed course series I have taken. Very excited to be part of this profession again.”
- “This has been the best course. There is so much useful information. I wish every PT who works with the elderly could take this course. We would change many lives.”
- “The comprehensive and exhaustive attention to evidence is incredible. The overall seriousness and enthusiasm of the team lends an air of urgency to the call for PTs to “GET WITH IT” in evaluating practice standards in our geriatric population.”
- “If this certification course hasn’t increased my practice standards, nothing will.”

The process to attain the CEEAA is to complete formal didactic education, and to participate in supervised and mentored skills development, home-based reflection, and critical thinking. Three courses of two days address 3 different and increasingly complex aspects of exercise design and delivery. The 3 courses are designed to build on each other; however, Courses 1 and 2 can be taken out of sequence. If you have taken part of the series but have not completed it, please contact the Section office at 866-586-8247 for information on how to complete your certification.

We have had ***sold out*** crowds, so don’t wait to sign up! We look forward to seeing you at any of the 2014 scheduled series!

If your site is interested in hosting this series, please contact Danille Parker, chair of the Regional Course Committee at Danille.parker@marquette.edu or 414-288-3179.

(Continued from page 26)

- All faculty are Mayo Clinic AZ clinical staff
- Didactic sessions are taught by clinicians holding academic rank in the Mayo Clinic College of Medicine as well as physicians and other allied health colleagues
- Rotation between clinical sites: Acute/critical care, IRF, OP, SNF/HH
- Mentors are clinicians who focus their practice in each setting and are neuro, ortho and geriatric board certified specialists.
- Opportunities to attend clinical rounds, observe specialty procedures, participate in care conferences and patient support groups and attend both intramural and extramural education offerings.
- Simulation lab utilized for teaching, baseline performance and practical exams

HUNTINGTON, WEST VIRGINIA GRADUATES

July 2013

Thank you to the School of Physical Therapy at Marshall University



Theodora Barenholtz, PT, CEEAA
Donn Bergman, PT, DPT, CEEAA
Emma Brillantes Park, PT, CEEAA
Maryann W. Brock, PT, DPT, CEEAA
Emarjun Brucal, PT, MHA, CEEAA
Sheilah Vinco Buenaventura, PT, CEEAA
Karen Burgbacher, PT, CEEAA
Justin Chaffin, SPT, CEEAA
Chethan Kumar Akkur Channe Gowda, PT, DPT, CEEAA
Richhpal Chaudhary, PT, CEEAA
Tirupathi Chindam, PT, DPT, CEEAA
Mary E. Conley, DPT, CEEAA
Christina Cooper, PT, NCS, CEEAA
Janet Cross, PT, CEEAA
Paul DeCarli, PT, CEEAA
Renee DeJarnette, PT, MHS, CEEAA
Ella Dodi-Monk, PT, DPT, CEEAA
Ahmed Elokda, PT, PhD, CEEAA
Angela D. Ferguson, PT, CEEAA
Sheryl Finucane, PT, PhD, CEEAA
Sara Francois, PT, DPT, CEEAA
Susan Freyder, PT, CEEAA
Tamara N. Gravano, PT, DPT, GCS, CEEAA
Shenita D. Haynes, PT, DPT, CEEAA
Constance L. Johnson, PT, MS, CEEAA

Lindsey Johnston, PT, DPT, CEEAA
Craig Markowski, PT, MPT, CEEAA
Tara Maroney, PT, DPT, GCS, CEEAA
Lynne Marshall, PT, CEEAA
Connie Marsh-Bartle, PT, CEEAA
Scott R. Milliken, PT, CEEAA
Karina Minarczik, PT, DPT, COS-C, CPFT, CEEAA
Lora Mock, PT, CEEAA
Felino E. Muego, PT, CEEAA
Elizabeth Murphy, PT, DPT, CEEAA
Irene Myers, PT, DPT, CEEAA
Yashvanth Nagarajamurthy Kuderu, PT, DPT, CEEAA
William Pearce, PT, GCS, MS, CEEAA
Helen A. Raymond, PT, BS, CEEAA
Ivan Salazar, PT, CEEAA
Jason Stubbs, PT, MPT, CEEAA
Trevor Swan, PT, CEEAA
Allison Swisher, PT, CEEAA
Joanie Thomas, PT, DPT, CEEAA
Madeline L. Versteeg, PT, CEEAA
Cami Watson, PT, CEEAA
Chara Whittemore, MSPT, CEEAA
Kristen Wolf, PT, DPT
Christina Zdilla, PT, DPT, CEEAA

AUBURN, WASHINGTON GRADUATES AUGUST 2013

**Thank you to Life Care Centers of America and the Physical Therapy
Assistant Program at Green River Community College**



Anjanette Ang, PT, CEEAA
Glenn Aricaya, PT, CEEAA
Terri Barrow, PTA
Barbara Bertucio, PT, CEEAA
Bruce Bradley, PT, CEEAA
Julie Burnett, PT, CEEAA
Nancy Burns, PT, CEEAA
Lanieline T. Carbungco, PT, CEEAA
Jenny Chang, PT, CEEAA
Cynthia M. Coffin-Greenig, PT, CEEAA
Amy Conrad, PT, CEEAA
April Jane G. Corros, PT, CEEAA
Jennifer Coulter, MPT, GCS, CEEAA
Michael Coussens, PT, CEEAA
Jennifer Dellinger, PT, CEEAA
Jeanne Dirksen, PT, CEEAA
Julie DiRusso, PT, CEEAA
Daniel English, DPT, CEEAA
Loriel May Fanunal, PT, CEEAA
Debra Fixman, PT, CEEAA
Jean L. Gibbons, PT, CEEAA
Lucy Glenn, PT, MS, CEEAA
Ann M. Green, PT, DPT, CEEAA
Barbara Hahn, PT, EdD, CEEAA
Dawn Hamman, PT, CEEAA
Denise Hansen, PT, CEEAA
Jake I. Hanson, PT, DPT, CEEAA
Sandra Harnden-Warwic, PT, GCS, CEEAA
Jessy Holdaway, PT, CEEAA
Lynde Howe, PT, CEEAA
Paula Hunt, PT, CEEAA
Francis Raymund Jarangue, PT, CEEAA
Stewart Louis Johnson, PT, CEEAA
Jongeun Yim, PT, CEEAA
Maria Geinah Labanero, DPT, CEEAA

Hannah Lanstrum, PT, DPT, CEEAA
Susan L. Lefever, CEEAA
Leslie Duff Lehman, PT, DPT, CEEAA
Rosemarie C. Luces, PT, CEEAA
Lori McCormick, PT, CEEAA
Margaret Moffatt, PT, CEEAA
Lisa Moore, PT, CEEAA
Jessica Kele Mordin, PT, CEEAA
Dean A. Myers, PT, CEEAA
Jean Myers, PT, GCS, CEEAA
Alicia Nowak, PT, CEEAA
Sue Parker, PT, CEEAA
Donette Parry, PTA
Honani Polequaptewa, PT, MPT, LMT, CEEAA
Marcia E. Powell, PT, DPT, CEEAA
Heather Ramsdell, MPT, CEEAA
Bryant T. Ransom, PT, DPT, CEEAA
Antonio Rodriguez III, PT, MCMT, CKTP, CEAS, CEEAA
Anne M K Schubert, PT, DPT, CEEAA
Susan Serbinski, PT, CEEAA
Sherry Simsuangco, PT, CEEAA
Patricia C. Slough, PT, CEEAA
Tamara Stanhope PTA
Laurie Swan, PT, PhD, DPT, CEEAA
Heidi Teachout, PT, CEEAA
Jennifer Templeton, PT, CEEAA
Julia A. Thompson, PT, CEEAA
Patricia P. Tobin, PT, CEEAA
Ingrid Van Anrooy, PT, DPT, CEEAA
Patricia Van Wagner, PT, GRCC, CEEAA
Julie A. Vernon, PTA
Jenny Wadman, PT, CEEAA
Barry Willis, MSPT, GCS, CEEAA
Conn Wittwer, PT, CEEAA

CHICAGO, ILLINOIS GRADUATES

September 2013

Thank you to the Rehabilitation Department at Swedish Covenant Hospital



Bernardine Gemma Aguirre, PT, DPT, CEEAA
Tara Anderson, MPT, CEEAA
Annamarie Asher, PT, NCS, CEEAA
Debra S. Barrett, PT, GCS, CEEAA
Holly Batistick - Aufox, DPT, MS, NCS, CEEAA
Maria Concepcion A. Bautista, PT, DPT, CEEAA
Heidi Bell, PT, CEEAA
Sonja Bye, PT, DPT, CEEAA
Kahlil Calvo, RPT, GTC, CEEAA
Caroline Cipriano Hanneman, PT, DPT, CEEAA
Gwen Dani, MPT, CEEAA
Judith Daniel, MSPT, GCS, CEEAA
Jeffrey S. DeGroote, PT, CEEAA
Laura deMilt, PT, DPT, GCS, CSCS, CEEAA
Barbara Ehrmann, PT, DPT, CEEAA
Donna Gerber, PT, DPT, GCS, CEEAA
Seema Gurnani, DPT, CEEAA
Dr. Mary Elizabeth Guyette, PT, DPT, CEEAA
Barbara Hanley, PT, DPT, MS, CEEAA
Karen Henrickson, PT, CEEAA
Marilyn Holt, PT, MHS, GCS, CEEAA
Khadam Hussain, PT, DPT, CEEAA
Jessica Karasek, PT, CEEAA
Renjan Karottu, MPT, CEEAA
Denise Kearns-Legoo, PT, GCS, CEEAA
David Kelley, DPT, CEEAA
Leslie Kuhagen, PT, DPT, CEEAA
Molly Menge Maguire, PT, CEEAA
Yousif David Malik, PTA
Alexander O. Manuel, PT, CEEAA

Ramil D. Mendoza, PT, DPT, CEEAA
James C. Milder, PT, CEEAA
Maria Rheena B. Montes, PT, CEEAA
Kristen M. Moore, MPT, CEEAA
Priscilla Mulesa, PT, MS, GCS, CEEAA
Abhi Munshi, PT, DPT, CEEAA
Melanie L. Navos, PT, DPT, CEEAA
Catherine O'Keeffe, MSPT, CEEAA
Angela Onyekanne, DPT, CEEAA
Maria Osborne, PT, CEEAA
Corinne Perry, PT, DPT, CEEAA
Jennifer Peterson, PT, CEEAA
Bhaskaran Raju Pillai, PT, CEEAA
Rachel Puda, DPT, CEEAA
Vesna Radjenovich, PT, CEEAA
Heather Rhoadarmer, PT, CEEAA
Karen S. Rudiger, MPT, CEEAA
Noe Santiago, PT, CEEAA
Mallory Schug, PT, DPT, CEEAA
Rafael Serrano, PT, DPT, CEEAA
Duncan A. Sharrits, PT, MHS, CEEAA
Jennifer Shetler, PT, CEEAA
Nicole Sleddens, PT, MPT, CEEAA
Polly Swingle, PT, CEEAA
Michelle Ugalde, PT, DPT, CEEAA
Victoria Vaillancourt, PT, MS, CEEAA
Leah G. Villanueva, PT, DPT, CEEAA
Cynthia M. Weinstein, PT, DPT, CEEAA
Staci Whitson, PT, CEEAA
Linda Yasukawa, PT, MS, CEEAA

Section on Geriatrics Directory

EDITORIAL BOARD

Meri Goehring, PT, PhD, GCS
Physical Therapy Department
Grand Valley University
College of Health Professions, Cook-DeVos Center
301 Michigan Street NE, Room 564
Grand Rapids, MI 49503

Patrice Antony
Orlando, FL

Jennifer Bottomley
West Roxbury, MA

Kathy Brewer
Phoenix, AZ

Chris Childers
San Marcos, CA

Helen Cornely
Miami, FL

Jill Heitzman
Auburn, AL

Lucy Jones
Blackwood, NJ

Ken Miller
Islip, NY

Melanie Sponholz
Cherry Hill, NJ

Bill Staples
Carmel, IN

Ellen Strunk
Birmingham, AL

BOARD OF DIRECTORS

Lucy Jones
Blackwood, NJ

Danille Parker
Muskego, WI

Sara Knox
Lynchburg, VA

Myles Quiben
San Antonio, TX

Delegate

Cathy Ciolek
Wilmington, DE

EXECUTIVE OFFICERS

President

William Staples
Carmel, IN

Vice President

Jill Heitzman
Auburn, AL

Secretary

Greg Hartley
Miami, FL

Treasurer

Anne Coffman
New Berlin, WI

COMMITTEE CHAIRS

Awards

Lee Ann Eagler
Lynchburg, VA

Practice

Greg Hartley
Miami, FL

Program

(CSM & Annual Conference)
Tiffany Hilton
Pittsford, NY

Sue Wenker
Stoughton, WI

PTA Advocate

Ann Lowrey
Oil City, PA

Home Study Course Editor

Cheryl Anderson
Alexandria, MN

Regional Courses

Danille Parker
Muskego, WI
Vicki Landers-Gines
Kansas City, MO

CEEAA Co-Chairs

Marilyn Moffat
Locust Valley, NY
Karen Kemmis
Syracuse, NY

Journal of Geriatric Physical Therapy

Richard W. Bohannon
W Hartford, CT

Public Relations

Karleen Cordeau
Goshen, CT

Listserv

Evan Post
Columbia, MO

Finance

Anne Coffman
New Berlin, WI

Membership Chair

Tamara Gravano
Huntington, WV

Nominating Committee

Missy Criss
Pittsburgh, PA

Reimbursement/Legislation Chair

Ellen Strunk
Birmingham, AL

Research

Jessie VanSwearingen
Pittsburgh, PA

Web Site

Lucy Jones
Blackwood, NJ

SPECIAL INTEREST GROUPS

Health Promotion & Wellness SIG

Lori Schrodt
Cullowhee, NC

Bone Health SIG

Sherri Betz
Santa Cruz, CA

Balance & Falls SIG

Mindy Renfro
Missoula, MT

LIAISONS

APTA Board Liaison

Laurie Hack
Bryn Mawr, PA

IPTOP Liaison

Lisa Dehner
Cincinnati, OH

SECTION ON GERIATRICS APTA

Section Executive

Karen Curran, CAE
Section on Geriatrics
3510 East Washington Avenue
Madison, WI 53704
Ph: 866/586-8247
Fax 608/221-9697
karen.curran@geriatricspt.org

SOG Website

<http://www.geriatricspt.org>

Geriatric Physical Therapy Listserv

Join at <http://groups.yahoo.com/group/geriatricspt> and click 'Subscribe.' When you receive an email confirming your subscription, you have full access to member areas of the site.

GERINOTES PUBLISHER

Sharon Klinski
2920 East Avenue South, Ste 200
La Crosse, WI 54601-7202
W 800/444-3982 x 2020
FAX 608/788-3965
sklinski@orthopt.org

Section on Geriatrics - APTA

GERINOTES

2920 East Avenue South, Suite 200
La Crosse, WI 54601-7202



Section on Geriatrics, APTA CSM 2014 Preconference Courses – Each worth .8 CEUs –

Tai Chi Fundamentals: Program Level One

Sunday, February 2, 2014, 8 am – 5:30 pm

Presenter: Kristi Hallisy, PT, DSc, OCS, CMPT, CTI

Tai Chi Fundamentals: Program Level Two

Monday, February 3, 2014, 8 am – 5:30 pm

Presenter: Kristi Hallisy, PT, DSc, OCS, CMPT, CTI

Mentoring: Residency & Fellowships

Monday, February 3, 2014, 8 am – 5:30 pm

Presenters: Carol Jo Tichenor, PT, MA, FAAOMPT,
Ivan Matsui, PT, BA, FAAOMPT, Gail Jensen, PT, PhD,
FAPTA, and Greg Hartley, PT, DPT, GCS

Co-sponsored by the APTA Education Section

**Course Space
is Limited!**



Visit www.apta.org and click events to register today!