

8-2013

Retrospective Study to Describe and Compare the Application of Select Sections of the STOPP/START and Beers Criteria in Medication Reviews in a Musculoskeletal Specialty Practice

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RETROSPECTIVE STUDY TO DESCRIBE AND COMPARE THE APPLICATION
OF SELECT SECTIONS OF THE STOPP/START CRITERIA AND THE BEERS
CRITERIA IN MEDICATION REVIEWS IN A MUSCULOSKELETAL SPECIALTY
PRACTICE

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Nursing

By

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2013
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Abstract

Problem: Selecting appropriate medications for the aging population is challenging considering the number of chronic illnesses, prescriptions, and healthcare providers involved in their care, not to mention age related changes that impact pharmacokinetics.

Significance: Inappropriate medications in geriatric patients can lead to adverse drug reactions (ADR). Medication review tools can assist in the identification of potentially inappropriate medications (PIM) to avoid or closely monitor and prevent ADRs.

Purpose: Describe and compare the application of select sections of the STOPP (Screening Tool of Older Persons Prescriptions) /START (Screening Tool to Alert to Right Treatment) and Beers Criteria in a geriatric population. Specific aims include describing and comparing: 1) the rate of PIM identified by sections of the Beers and STOPP Criteria, 2) the rate of potential prescription omissions (PPO) identified by a section of the START Criteria, 3) the most common PIM or PPO drug classes identified, 4) those with polypharmacy (>5 medications), and 5) the time for criteria application.

Design: Retrospective descriptive, comparative chart review.

Results: A total of 468 medications were prescribed, an average of 7.43 per patient, with 73.02% of patients with polypharmacy. Beers Criteria identified 32 PIM in 39.7% while STOPP Criteria identified 67 PIM in 58.7%. There was a high statistical difference between the number of PIM identified by the STOPP Criteria compared to the Beers Criteria ($P=0.01$). A total of 16 PPO were identified with START Criteria in 17.5%.

Keywords: potentially inappropriate medication, potential prescription omissions, STOPP/START Criteria, Beers Criteria, adverse drug reactions

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Chapter One: Introduction

Introduction

In the United States (U.S.) the geriatric population, individuals 65 years and older, is growing (Patterson, Hughes, Kerse, Cardwell, Bradley, 2012; Hajjar, Cafiero, Hanlon, 2007). According to the 2010 census, 40 million Americans are 65 years of age and older. It is estimated the geriatric population will increase to 72 million or 20 percent of the national population by 2030 as the baby boomer generation reaches advanced age (Federal Interagency Forum on Aging, 2010). Advanced age is associated with multiple normal aging changes. These changes coupled with increased numbers of chronic diseases, increased numbers of healthcare providers, and multiple medications increase the complexity of the plan of care (Opondo, Eslami, Visscher, Rooij, Verheij, Korevaar, Abu-Hanna, 2012; Cahir, Fahey, Teeling, Teljeur, Feely, Bennett, 2010; Ramaswamy, Maio, Diamon, Talati, Hartmann, Arenson, Roehl, 2010).

Forty percent of geriatric patients are currently taking five or more medications to treat their chronic diseases, placing them at a higher risk for potentially inappropriate medications (PIM), leading to possible adverse drug reactions (ADR) (Therapeutic Research Center, 2011; Pham & Dickman, 2007). The most common ADRs include falls, fractures, and delirium which can impact functional ability and quality of life (Pham & Dickman, 2007). For these reasons, the problem of PIM is a growing concern among providers who prescribe medications for the geriatric population.

Utilizing a medication screening tool in outpatient settings within the U.S. may be an effective method for preventing PIM and decreasing potential for ADR in geriatric patients. Medication screening tools are not meant to replace clinical judgement, but

rather to encourage closer monitoring or use of certain medications that could be potentially inappropriate or lead to ADR (Cahir et al, 2010). The American Geriatric Society recommends the use of the Beers Criteria while the European Union Geriatric Medicine Society recommends the STOPP (Screening Tool of Older Persons' Prescriptions)/START (Screening Tool to Alert doctors to Right Treatment) Criteria as a medication screening tool (Fick & Semla, 2012; Marcum & Hanlon, 2012). Both criteria are explicit screening tools created by expert consensus panels that may be generalizable to the geriatric population (Cahir et al, 2010).

The Beers Criteria is organized into lists of medications to avoid or use with caution while the STOPP/START Criteria is organized by body system into lists of medication recommendations to either discontinue or initiate (American Geriatric Society, 2012; Gallagher, Ryan, Byrne, Kennedy, O'Mahony, 2007). Considering the most common ADRs of falls and fractures, and the high number of geriatric patients suffering from musculoskeletal conditions, including osteoarthritis (OA) and osteoporosis (OP,) the Beers and STOPP Criteria have sections that may be useful to identify PIM and the START to identify potential prescription omissions (PPOs) associated with these common conditions. Both criteria were reviewed in their entirety to ensure similar sections had been chosen from each criteria. These sections include the 1) Beers history of falls and fracture section, 2) Beers pain medication section, 3) Beers history of gastric ulcers, 4) Beers history of chronic kidney disease, 5) STOPP central nervous system and psychotropic drugs section, 6) STOPP musculoskeletal drugs section, 7) STOPP drugs that adversely affect those prone to falls section, 8) STOPP analgesic drugs, and 9) START musculoskeletal drug sections. The Beers Criteria sections three and four were

selected due to their similarity with the STOPP/START Criteria's musculoskeletal sections (sections six and nine). The STOPP Criteria section five was selected because of its similarity with the Beers history of falls and fractures section (section one). Pain medication sections from each criteria were included because of the high risk for falls, confusion, and delirium in geriatric patients related to these medications.

Therefore, the purpose of this retrospective study was to describe and compare the application of select sections of the STOPP/START and Beers Criteria in a geriatric population in a musculoskeletal specialty setting in the United States. The aims of the present study were to describe and compare: 1) the rate of PIM identified by specific sections of the Beers Criteria (Appendix B) and specific sections of the STOPP Criteria (Appendix A), 2) the rate of PPO identified by a specific section of the START Criteria (Appendix A), 3) the most common PIM or PPO drug classes identified by each criteria; 4) identify those with polypharmacy (greater than 5 medications, and 5) the length of time for application of each criteria.

Chapter Two: Literature Review & Theoretical Framework

Literature Review

Americans, age 65 years and older, increased by 15.3 percent between the years 2000 and 2010. Now one in every eight people is over 65 years of age (Administration on Aging U.S. Department of Health and Human Services, 2011). Individuals over 65 years of age experience multiple normal aging changes and an increased chronic disease burden. Over two thirds of Medicare beneficiaries have two or more chronic diseases and 14 percent have six or more (Centers for Medicare & Medicaid Services, 2012). In 2007, geriatric patients went to a healthcare provider seven times more often than younger patients and were three times more likely to be admitted to the hospital (Administration on Aging U.S. Department of Health and Human Services, 2011). Fall induced osteoporotic fractures are the leading cause of hospitalization in geriatric patients and falls are their leading cause of injury related death (CDC, 2012; Dalleur, Sinewine, Henrared, Losseau, Speybroeck, Boland, 2012). One in three geriatric patients, 65 years and older, fall each year (Kojima, Akishit, Nakamaura, Nomaura, Ogawa, Iijima, Eto, Ouchi, 2010; Ziere, Dieleman, Hofman, Pols, Van der Cammen, Stricker, 2005; Hegeman, van den Bemt, Duysens, Limbeek, 2009). The cost for treatment of falls in the U.S. was \$30 billion in 2010 (CDC, 2012).

Several normal aging changes and chronic diseases may increase the risk of falls and consequently a serious injury, including fractures (Gallagher et al, 2007). Some of these normal aging changes include hearing impairment, changes in vision, diminished coordination and reflexes, and decreased bone density (American Psychology Association, 1998; Whitaker, 2011; Klotz, 2009; Clyne, Bradley, Smith, Hughes,

Motterlini, Clear, McDonnell, Williams, and Fahey, 2013). The most common chronic diseases that affect the musculoskeletal system are arthritis and osteoporosis (OP) (Kiebzak, 2002; Trivedi, Doll, Knaw, 2003). Arthritis affects half of all geriatric patients, 75 years and older, and they often experience significantly decreased functional ability and quality of life as a result of their disease (CDC, 2010). Osteoporosis affects 52 million men and women in the U.S. and decreased bone density predisposes these men and women to fractures (Whitaker, 2011). One in three women and one in five men, age 50 and older, will at some point suffer a fracture as a result of OP (International Osteoporosis Foundation, 2013).

A normal aging change in pharmacokinetics also increases the risk of falls through increased likelihood of ADR (American Psychology Association, 1998; Hamilton, Gallagher, Ryan, Byrne, O'Mahony, 2011). Pharmacokinetics involves the effect the body has on medications including absorption, distribution, metabolism, and excretion (Brouwer & Olney, 2004; Shahezwan, Wahab, Nyfort-Hansen, Kowalski, 2012). Absorption of medications becomes slowed with advancing age. Distribution of medications is affected by sarcopenia. Sarcopenia is the normal, age related loss of muscle mass and strength and is one of the biggest indicators of functional ability (Brouwer & Olney, 2004). Metabolism and excretion of medications is affected by the normal, age related decrease in renal and hepatic function (Williams, 2002).

Healthcare providers often struggle to find a balance between over prescribing and under prescribing medications to treat or prevent disease in geriatric patients, especially because chronic diseases often require more than one medication for treatment (Patterson et al, 2012; Klotz, 2009; Williams, 2002). In the U.S., prevention and

treatment of disease are often achieved with pharmaceuticals, but with more medications comes the increased likelihood of an ADR (Werder & Preskorn, 2003; Perry 2008). The U.S. General Accounting Office (1995) concluded that although, at that time, the geriatric population made up only about 15 percent of the U.S. population, they accounted for the purchase of 33 percent of prescription medications and 40 percent of over the counter medications.

The most commonly used over the counter medications among geriatric patients, often used to treat OA are non-steroidal anti-inflammatory drugs (NSAIDs) (Page, 2000; Ejaz, Bhojani, Joshi, 2004; Yayla et al, 2013; Pretorius, Gataric, Swedlund, Miller, 2013; Berryman, Jennings, Ragsdale, Lofton, Huff, & Rooker, 2012). NSAIDs increase systemic vascular resistance and can cause impaired renal perfusion leading to hypertension, congestive heart failure development or exacerbations, and kidney dysfunction (Page, 2000; Ejaz et al, 2004). The use of NSAIDs is associated with an increased risk for gastrointestinal issues possibly leading to ulcers or bleeding, and central nervous system problems possibly leading to falls (Hegeman et al, 2009; Yayla et al, 2013).

Some of the other most common PIMs used in geriatric patients are long-term opiates, benzodiazepines, and antihistamines (Shahezwan et al, 2012; Beers, Ouslander, Rollinger, Reuben, Brooks, Beck, 1991; Beers, 1997; Fick, Cooper, Wade, Waller, Maclean, Beers, 2003; Ryan, O'Mahony, O'Donovan, O'Grady, Weedle, Kennedy, Byrne, 2012; American Pharmacists Association, 2012). These medications can cause drowsiness, confusion, hypotension, bradycardia, and muscle weakness, increasing the risk of falls (Shahezwan et al, 2012). Additionally, antihistamines can cause agitation,

hallucinations, delirium, and can contribute to cardiovascular disorders including dysrhythmias, prolonged QT intervals and postural hypotension in patients 65 years of age and older (American Pharmacists Association, 2012; Coggins, 2013).

For the reasons previously discussed, geriatric patients are more susceptible to PIM possibly leading to an ADR than younger patients (Gallagher et al, 2007; Shahezwan et al, 2012). Geriatric patients with polypharmacy, more than five daily medications, have a one in three chance of experiencing an ADR as a result of an inappropriate medication and two thirds of those patients will need to seek medical care for that reaction. Adverse drug reactions lead to increased healthcare utilization and cost (Gallagher et al, 2007). In 2007, 12.9 million geriatric patients had at least one hospitalization as a result of an ADR lasting three to six days (Administration on Aging U.S. Department of Health and Human Services, 2011). Ninety five percent of those ADRs are predictable and 28 percent are preventable (Pham & Dickman, 2007). The most common ADR include falls, hip fractures, delirium, and urticaria all possibly leading to increased healthcare costs, decreased functional ability, and decreased quality of life (Pham & Dickman, 2007).

Consideration of the normal physiologic changes of aging, recalling knowledge of pharmacology and realizing the possibility for patient harm could be helpful in preventing PIM. Inappropriate medications may also be prevented with regular medication reviews using a screening tool for guidance. Medication reviews are recommended whenever a patient is seen for the first time, every six to 12 months, and whenever a new medication is being considered or prescribed (Pham & Dickman, 2007; Ryan, 2012). Medication reviews may be helpful in promoting the aggressive treatment

of disease and minimizing the potential for ADR (Cahir et al, 2010; Steinman, 2007).

There are two different kinds of medication review processes including implicit measures and explicit measures. Implicit measures allow providers to use their clinical judgement to determine what is appropriate for each patient on an individual basis. Explicit measures are based on guidelines and criteria developed by expert panels and consensus opinion that should be generalizable to all patients in all situations (Cahir et al, 2010). There are several explicit screening tools available for providers to utilize when conducting a medication review or considering prescribing a new medication for a geriatric patient.

Beers Criteria

The most popular explicit medication screening tool used in the U.S. and currently recommended by the American Geriatrics Society, National Committee for Quality Assurance, Pharmacy Quality Alliance, and Centers for Medicare and Medicaid Services is the Beers Criteria developed by Mark Beers M.D. and an expert consensus panel in 1991 and updated in 1997, 2003, and 2012 (Cahir et al, 2010; O'Mahony, Gallagher, Byrne, Hamilton, Barry, O'Connor, Kennedy, 2010; Vishwas, Harugeri, Parthasarathi, Ramesh, 2012; Ryan, O'Mahony, Kennedy, Weedle, Byrne, 2009; Pham & Dickman, 2007; Shahezwan et al, 2012; Ramaswamy et al, 2010; Fick & Semla, 2012; Resnick & Pacala, 2012; Cherubini, Corsonello, Lattanzio, 2012; Vieira de Lima, Garbin, Garbin, Sumida, Saliba, 2013; Gillespie, Alassaad, Hammarlund-Udenaes, Morlin, Henrohn, Bertilsson, Melhus, 2013). The American Geriatric Society recommends that the Beers Criteria will be updated every three years to remain current (Marcum & Hanlon, 2012; Campanelli, 2012). The 2012 updated Beers Criteria is made up of 53

medications divided into three sections including 1) PIM and classes to avoid in geriatric patients independent of diagnosis, 2) PIM and classes to avoid considering certain disease processes in geriatric patients, and 3) medications to use with caution in geriatric patients (American Geriatric Society, 2012).

In 2012, an expert consensus panel updated Beers Criteria by removing medications no longer available, adding medications new to the market since 2003, updating the list of common geriatric diseases, adding a list of medications to use with caution, and adding new research (Gallagher et al, 2007; Ryan et al, 2009; Pham & Dickman, 2007; Fick & Semla, 2012; Resnick & Pacala, 2012). With the addition of new research, a rating of the quality and strength of the evidence and recommendation is given for each medication, regardless of whether it is classified by drug category or disease process (American Geriatric Society, 2012; Resnick & Pacala). The expert consensus panel emphasizes the Beers Criteria should never replace clinical judgement, but rather serve as a reminder to closely monitor or avoid, if possible, certain medications in the geriatric population (Resnick & Pacala, 2012; Campanelli, 2012). As a reminder for clinical practice, Fick and Semla (2012) propose the updated criteria could be easily implemented into an electronic medical record and provide prompts and possibly alternative interventions when a PIM has been identified.

The Beers Criteria has been examined extensively in research since its development and found to be effective in identifying PIM and advising close monitoring of certain medications (Gillespie et al, 2013). However, evidence supporting the effectiveness of the Beers Criteria in consistently reducing ADR or decreasing cost or mortality is lacking (Spinewine, Schmader, Barber, Hughes, Lapane, Swine, Hanlon,

2007; Jano & Aparasu 2007; Resnick & Pacala, 2012; Pham & Dickman, 2007). The Beers Criteria does not take into account geriatric patients in palliative care or hospice, does not detect prescribing omissions, underuse of medications, drug to drug interactions, inappropriate dosing of medications, or duplication of drug classes (Shahezwan et al, 2012; Barry et al, 2007; Gallagher et al, 2007; Fick & Semla, 2012).

STOPP Criteria

A newer physiological systems based explicit screening tool is the STOPP/START Criteria, developed in Europe in 2003, and validated with a Delphi consensus for use in 2006 (Gallagher et al, 2007). The STOPP/START Criteria is used to detect PIM being prescribed and to identify PPO. Eighteen experts in Geriatric Pharmacotherapy from Ireland and the United Kingdom participated in two rounds of the Delphi validation process (Gallagher et al, 2009; Dalleur et al, 2012; Gallagher et al, 2007; Yayla, Bilge, Binen, Keskin; 2013). The criteria, last updated in 2006, are broken down by body system, take into account specific patient information, and are separated into a list of PIM to STOPP and a list of PPO to START. The STOPP/START Criteria are supported by the European Union of Geriatric Medicine Society (EUGMS) and was slated for an updated validated version in late 2012 or early 2013 (Marcum & Hanlon, 2012). The criteria is helpful in completing medication reviews because it considers the patients diagnosis and past medical history, PIM, PPO, duplicate drug classes, duration of treatment errors, and medications likely to cause a fall (Shahezwan et al, 2012; Gallagher et al, 2009; Barry, Gallagher, Ryan, O'Mahony, 2007; Gallagher et al, 2007).

The STOPP Criteria contains 65 evidence based indicators for potentially inappropriate prescribing with an explanation for why the medication could be

inappropriate in a geriatric patient appearing next to each criteria (Gallagher et al, 2009; Dalleur et al, 2012; Gallagher et al, 2007; Onatade, Auyeung, Scutt, Fernando, 2013). The STOPP Criteria can be used as a medication screening tool effectively even without a patient's past medical history or other clinical information (Ryan et al, 2012). It is believed to be comprehensive and time efficient (Gallagher et al, 2007). The STOPP Criteria takes approximately three minutes per patient to use and could readily be incorporated into an electronic medical system for easier application (Gallagher, O'Connor, O'Mahony, 2011; Ryan et al, 2009; Gallagher et al, 2009; Dalleur et al, 2012).

START Criteria

The START Criteria contains 22 evidence based indicators for prescribing omissions with an explanation for why the medication could be indicated in a geriatric patient appearing next to each criteria (Gallagher et al, 2009; Dalleur et al, 2012). The most effective method to apply this criteria as a medication screening tool is to have a patient's past medical history and other clinical information available (Ryan et al, 2012). Physicians may be cautious to prescribe medications to geriatric patients out of fear related to multiple co-morbidities, fear of polypharmacy, economic reasons, or ageism (Cherubini, Corsonello, Lattanzio, 2012). However, this criteria has compiled a list of medications that are indicated to prevent or treat disease and can be applied in one minute (Cherubini, 2012; Beer, Hyde, Almeida, 2011; Gallagher, O'Connor, O'Mahony, 2011; Ryan et al, 2009; Gallagher et al, 2009).

Review of current literature revealed the two most common prescription omissions were Calcium and Vitamin D supplements in OP and high fall risk men and women (Sloane, Gruber-Baldini, Zimmerman, Roth, Watson, Boustant, 2004; Rosen,

Karter, Liu, Selby, Schneider, 2004; Kiebzak, Beinart, Perser, Ambrose, Siff, Heggeness, 2002; Trivedi, Doll, Khaw, 2003). Prevention and treatment of OP may be improved in older adults with simple treatments like an appropriate single monthly dose of Calcium and Vitamin D (Kiebzak, 2002; Trivedi, Doll, Khaw, 2003). Bisphosphonates are also indicated for the treatment of OP and have been shown effective in preventing fractures (Whitaker, Guo, Kehoe, Benson, 2012).

The goal for the use of a medication screening tool in practice is to allow prescribers to use their expertise and clinical judgement in a timely manner as the tool should be evidence-based, simple to use, and work well with an electronic medical record (O'Mahony et al, 2008). There are several concerns expressed with both criteria.

Concerns with the Beers Criteria include poor organization, inefficiency, missing medications and interactions, and duplicate medications and prescribing omissions are not addressed (Ryan et al, 2009; O'Mahony, 2012; Cahir et al, 2010; O'Mahony et al, 2010; Shahezwan et al, 2012; Fisk & Semla, 2012; Barry et al, 2007; Campanelli, 2012).

Concerns with the STOPP/START Criteria include that existing research are reviews rather than clinical studies, the last update was seven years ago, and there is a lack of research conducted with the criteria in the United States (Bradley, Fahey, Cahir, Bennett, O'Reilly, Parsons, and Hughes, 2012; Yayla et al; 2013; O'Mahony et al, 2010). The Beers Criteria has been studied extensively in the U.S. and the STOPP/START Criteria has been studied in a variety of settings across Europe; but minimally in the U.S. (Cahir et al, 2010; O'Mahony, Gallagher, Byrne, Hamilton, Barry, O'Connor, Kennedy, 2010; Vishwas, Harugeri, Parthasarathi, Ramesh, 2012; Ryan, O'Mahony, Kennedy, Weedle, Byrne, 2009; Pham & Dickman, 2007; Shahezwan et al, 2012; Ramaswamy et al, 2010;

Fick & Semla, 2012; Resnick & Pacala, 2012; Gallagher et al 2008; Lang Hasso, Belmin, Payot, Baeyens, Vogt-Ferrier, Gallagher, O'Mahony, Michel, 2009, Cherubini et al, 2012; Ubeda, Ferrandiz, Maicas, Gomez, Bonet, Peris, 2012, Windsant-van den Tweel, Windsant-van den Tweel, Verduijn, Derijks, van Marum, 2012).

There are many similarities between the Beers Criteria and the STOPP/START Criteria, therefore, studies have been conducted in Europe to compare the two criteria. The Beer's Criteria has a disadvantage in European studies versus the STOPP/START Criteria because some of the medications that appear on the Beers Criteria are not available in Europe (Yayla et al, 2013). Overlooking this disadvantage, European research suggests STOPP Criteria may be more sensitive and possibly more effective than the Beers Criteria at identifying PIM and preventing ADRs. This increased sensitivity may be attributed to the 33 PIM that appear on the STOPP Criteria that are not present on the Beers Criteria (Gallagher et al, 2007; Gallagher, O'Mahony, 2008; Hamilton et al, 2011; O'Mahony et al, 2010; Ryan et al, 2009).

Hamilton and colleagues (2011) found in 151 potentially avoidable ADR that led to hospitalization in Ireland, 94 were found in the STOPP Criteria compared to 34 identified by the Beers Criteria. Ryan and colleagues (2009) found in Irish primary care that the Beers Criteria identified PIM in 18.3 percent of patients, STOPP Criteria identified PIM in 21.4 percent, and START Criteria identified PPO in 22.7 percent of patients. Gallagher and colleagues (2011) determined that appropriate prescribing is significantly improved after correct and rigorous application of STOPP/START, even if only applied one time. Gallagher and colleagues (2008) found a significant difference in the detection of PIM. Hill-Taylor and colleagues (2013) conducted a systematic review

and determined the STOPP/START Criteria may be more sensitive than the 2003 version of the Beers Criteria.

The previous studies were conducted in European settings. Few studies have examined the STOPP/START Criteria in the U.S., Brahmbhatt and colleagues (2013) applied the STOPP/START Criteria in the U.S. and found a significant decrease in the number of medications triggered as inappropriate after initial and follow-up application of the criteria. With the limited research conducted in the U.S., especially in comparing the STOPP/START Criteria and the Beers Criteria additional research needs to be conducted in the U.S. to determine which criteria is more appropriate or effective in minimizing inappropriate medications and ADRs.

Theoretical Framework

Inappropriate medications increase the likelihood of ADR. Adverse drug reactions include a negative reaction to pharmacotherapy including confusion, depression, constipation, falls, fractures, delirium, possible hospitalization, and mortality (Cahir et al, 2010; Shahezwan, 2012; Hamilton, 2009; Brahmbhatt, Palla, Kossifologos, Mitchell, and Lee, 2013; Pretorius et al, 2013). Potentially inappropriate medications may be detected with a medication review (Hamilton, Gallagher, O'Mahony, 2009; O'Sullivan, O'Mahony, Parsons, Murphy, Patterson, Byrne, 2013). A medication review is a structured examination that involves identifying all current prescription, over-the-counter, and complementary medications an individual is taking in an attempt to agree about their treatment, decrease cost, and prevent or minimize inappropriate medications (NHS Cumbria Medicines Management Team, 2013; Pretorius et al, 2013).

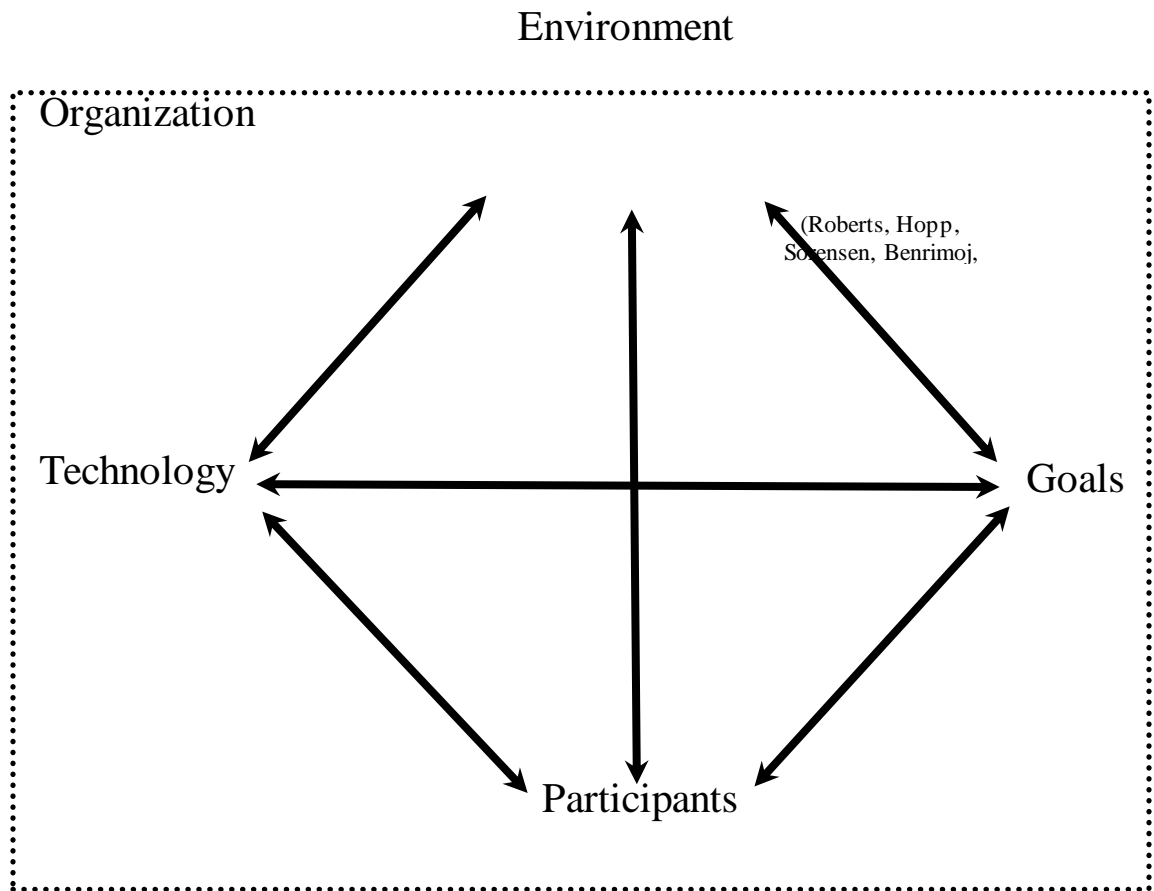
Medication reviews should be conducted when a patient is seen for the first time, every six months or annually, when a new medication is prescribed, or when there is a transition of care (Feinberg and Simonson, 2005, Barnsteiner, 2008; Pham & Dickman, 2007; Ryan 2012). More than 40 percent of PIM are present because medication reviews were not conducted during a transition of care (Barnsteiner, 2008). Critical review of medication lists in geriatric patients often results in change (Cockburn, 1997; Taziaux, Franck, Ludovicy, Albert, 1996). Therefore, if a medication review tool is regularly utilized to assess medication lists, some PIM may be discontinued and some PPO may be initiated resulting in improved patient safety and decreased morbidity (Hamilton et al, 2009, O'Sullivan et al, 2013; Hill-Taylor, Sketris, Hayden, Byrne, O'Sullivan, Christie, 2013).

Patient safety is the goal of healthcare providers and the organizations in which they function. Medication screening tools may be a simple and effective means to promote and achieve the goal of increased patient safety by screening for PIM or PPO. Effectiveness of a medication review depends on the environment, including how much time the provider is able to spend with a patient, the thoroughness of the reported medication list, and a familiarity with the patient's medical and social history.

Scott's Adaptation of Leavitt's Diamond

Leavitt's Diamond is an organization model created by Harold J. Leavitt in 1965 (Bloomsbury Business Library, 2007). Leavitt created a diamond shaped visual as a way to understand the model that an organization exists within its environment and does not experience change in isolation, but rather as change occurs to one part of the diamond it will impact every other part (Bloomsbury Business Library, 2007). In 1998, W. Richard

Scott, a sociology professor at Stanford University, adapted Leavitt's original diamond. The four corners of Scott's adaptation of Leavitt's diamond include 1) technology, 2) participants, 3) social structure, and 4) goals (Wilson, 1995; Roberts, Hopp, Sorensen, Benrimoj, Chen, Herborg, Williams, and Aslani, 2003). Scott's adaptation of Leavitt's Diamond serves as the theoretical framework for this study.



Conceptual and Operational Definitions

In Scott's model the entire organization exists within an environment and all the parts work together. The 1) technology refers not only to the computers and machines used within the organization but also the protocols, guidelines, and resources that are used to promote quality and achieve goals. The 2) participants are the people involved in the organization. The 3) social structure is the culture or relationship the participants have

with the organization and could include the way participants interact with one another, financial resources, the physical environment the organization exists within, etc. The 4) goals are the outcomes the participants and organization are trying to achieve. The goals of an organization must be the same for all participants for true success to be achieved. The strength and success of the entire organization relies on the knowledge, skills, and dedication of the participants. Every part of the diamond affects the others and requires the others to function (Wilson, 1995; Roberts et al, 2003).

The present study is examining the 1) technology corner, the 2) participants corner, and the 3) social structure corner of the Scott's model. The 1) technology for this study is operationally defined as medication screening tools specifically, sections of the Beers Criteria and the STOPP/START Criteria. The 2) participants for this study are patient medical records and the 3) social structure is the setting of a musculoskeletal specialty practice.

Potentially inappropriate medications are those that pose a greater risk than benefit for the patient (Shahezwan, 2012; Gallagher, Baeyens, Topinkova, Madlova, Cherbuini, Gasperini, Cruze-Jentoft, Monero, Lang, Michel, O'Mahony, 2009; Gallagher, Ryan, Byrne, Kennedy, O'Mahony, 2007; O'Mahony et al, 2008; Ramaswamy et al, 2010; Parsons, Johnston, Mathie, Baron, Machen, Amador, Goodman, 2012). This encompasses polypharmacy, medication duplication, PPO, dosage errors, duration of treatment errors, and prescribing cascades (Gallagher et al, 2007; Shahezwan et al, 2012). Polypharmacy does not have a consensus definition in literature but many studies cite five or more medications as a common occurrence and the point at which patients become more likely to experience an ADR (Pham & Dickman, 2007; Williams, 2002; Olsson,

Runnamo, Engfeldt, 2011; Dovjak, 2012). For the purpose of this study, polypharmacy means taking five or more medications (Kaufman, Kelly, Rosenberg, Anderson, Mitchell, 2002; Pham & Dickman, 2007). Medication duplication occurs when multiple drugs from the same class are being taken. Dosage errors occur when a medication is being taken at a dose with higher or lower than what is indicated for treatment. Duration of treatment errors include a medication being taken for either too many or too few days. Prescribing cascades include when a patient develops an unexpected side effect from one medication that is mistaken as another disease process and requires treatment from another medication (Rochon & Gurwitz, 1997). Potential medication omissions occur when a medication indicated for treatment is not being taken (Cherubini et al, 2012).

In the U.S. the Beers Criteria has been used extensively to identify PIM in the geriatric population. Currently there is not enough research evidence to make a recommendation for prescribers in the U.S. to use the STOPP/START to identify PIM. There is a need to apply both the STOPP/START and the Beers Criteria to the same geriatric population in a U.S. setting to describe and compare their application. A musculoskeletal specialty setting in the midwest was selected as an ideal setting due to the ability to review the medical records of geriatric patients who suffer from chronic conditions including OA, OP, falls, and fractures.

Chapter Three: Methodology

Research Design

The research design for this study was a retrospective descriptive, comparative design. A chart review was completed for the purpose of describing and comparing the appropriateness of the Beers Criteria versus the STOPP/START Criteria in identifying PIM or PPO in a U.S. setting.

Criteria Validity

The Beers Criteria content validity was established in 1991. Validity was established using two rounds of Delphi consensus methodology with a panel of 13 experts. Most recently in 2012 the American Geriatric Society sponsored 11 experts to update and revise the 2003 Beers Criteria (Marcum & Hanlon, 2012).

The STOPP/START Criteria's content validity was established using two rounds of Delphi consensus methodology in 2003 and 2006. A panel of 18 experts in geriatric medicine, pharmacotherapy, old age psychiatry, and primary from Ireland and UK collaborated to establish the final STOPP/START Criteria. The final STOPP Criteria contains 65 of the original proposed 68 criteria and all 22 of the original START Criteria (O'Mahony et al, 2009). The criteria has strong inter-rater reliability with a kappa coefficient for STOPP 0.88 and START 0.90 among pharmacists and STOPP 0.75 and START 0.68 among physicians (Ryan et al, 2009; Gallagher et al, 2009).

Setting

The setting of this study was a musculoskeletal specialty practice in the Midwest. This setting offered a large volume of geriatric patients with risk for falls, fractures, and musculoskeletal conditions including OA and OP.

Participants

The participants of this study were a convenient sample of patient medical records from a musculoskeletal specialty practice. The sample size for this study was 60 medical records.

Inclusion criteria included both males and females, of all races and ethnicities. Participants were all 65 years of age or older, seen at the practice within a six month period (December 2012-May 2013), and took at least one prescription medication on a regular basis. Participants had at least one of the following diagnoses which are included in the STOPP/START Criteria: OA, OP, gout, atrial fibrillation, hypertension, congestive heart failure, peptic ulcer disease, gastrointestinal bleed, renal failure, Parkinson's, chronic pain, anxiety, depression, insomnia, or seasonal allergies. Exclusion criteria included nursing home residents, because they are not living in the community and those with diagnosed terminal illnesses because neither criteria is based on care of terminal patients.

Data Collection

Data was collected in July 2013 from an electronic charting system. 1) Records were accessed electronically by one researcher. 2) Selection began by electronically identifying the records of patients seen during a six month period (December 2012-May 2013). 3) Records were then assessed for inclusion and exclusion criteria, specifically past medical history, up to a convenient sample of 63 participants. Based on expected attrition, three charts were added to the calculated sample size of 60. 4) The charts were then coded one through 63 to ensure patient privacy. 5) Once 63 records were found that met inclusion criteria, demographic data was collected as available (Appendix C). 5) The

a. STOPP Central Nervous System & Psychotropic Drugs, b. STOPP Musculoskeletal System Drugs, c. STOPP Drugs that Adversely Affect those Prone to Falls, and d. STOPP Analgesic Drugs (Appendix A) were applied to each medical record. 6) The START Musculoskeletal System Criteria (Appendix A) was applied to each medical record. 7) The Beers Criteria PIM to avoid by therapeutic category a. Antihistamines, b. Pain Medications, and PIM to avoid by disease/syndrome c. History of Falls or Fractures, d. History of Gastric Ulcer and Duodenal Ulcers, e. Chronic Kidney Disease were applied to each medical record. The application of each criteria to each individual medical record was timed. 8) Confidentiality and privacy were ensured with a systematic approach, only identifying the patients by one through 63, and keeping collected information locked.

Data Analysis

Data was analyzed on SPSS version 21.0 (IBM corp, 2012). The demographic and past medical history characteristics of the sample were identified using descriptive statistics reported as percentages, frequencies, means, and standard deviations. 1) Rate of PIM identified by specific sections of the Beers Criteria (Appendix B) and specific sections of the STOPP Criteria (Appendix A), 2) Rate of PPO identified by a specific section of the START Criteria (Appendix A), 3) most common PIM or PPO drug classes identified by each criteria, and those 4) identified with polypharmacy, and 5) length of time for application of each criteria was also identified using descriptive were identified using descriptive statistics reported as percentages, frequencies, means, and standard deviations.

Ethical Considerations

Approval from the Institutional Review Board at Cedarville University and the musculoskeletal specialty practice was obtained in June 2013. Due to the nature of this retrospective study design, the researcher had no contact with the individual patient, and no patient harm was anticipated. An ethical consideration was protecting patient's health information. To protect patient's privacy, the only data collected was information that appeared on the approved demographic collection tool and the two criteria. No patient identifiers were collected, patients were identified from one to 63.

Chapter 4: Results

Sample Characteristics

A total of 63 medical records were identified and included in this retrospective descriptive, comparative chart review. Table one summarizes the demographic characteristics of the sample. The mean age of patients was 74 ± 7.2 years, 95.2% were Caucasian, and 60.3% were females. The total number of medications prescribed was 468, with a range of 1-25 medications per patient and a mean of 7.43 medications per patient. The most common chronic disease identified was OA in 98.4% of the sample.

Table 1

Demographic Data

| Characteristic | No. (%) | Mean (SD) | Range |
|-----------------------------------|-----------|-------------------|-------|
| Male | 25 (39.7) | | |
| Age | | 74.68(\pm 7.2) | 65-95 |
| Race | 60 (95.2) | | |
| Caucasian | 2 (3.2) | | |
| African American | 1 (1.6) | | |
| Asian/Pacific Islander | | | |
| Insurance | | | |
| Private | 8 (12.7) | | |
| Medicare | 26 (41.3) | | |
| Medicare with Secondary Carrier | 29 (46) | | |
| Hospitalizations in the last year | 4 (6.3) | | |
| Falls in the last 3 months | 3 (4.8) | | |
| Most common Chronic Diseases | | | |
| Osteoarthritis | 62 (98.4) | | |
| Hypertension | 49 (77.8) | | |
| Hyperlipidemia | 27 (42.9) | | |
| Hypothyroidism | 12 (19) | | |
| Depression | 11 (17.5) | | |
| Osteoporosis | 10 (15.9) | | |

Rates of PIM

Beers Criteria results. Table two summarizes PIM identified by sections of both the Beers and the STOPP Criteria. After applying the Beers Criteria, a total of 32 PIM were identified in 39.7% of medical records, with 72% of PIM being prescribed to females. Twenty two (68.8%) medical records with PIM had one medication identified and five (31.3%) medical records with PIM had two medications identified.

STOPP Criteria results. After applying the STOPP Criteria a total of 67 PIM were identified in 58.7% of medical records. Females were prescribed 67.6% of PIM. Seventeen (25.4%) medical records with PIM identified one medication, 13 (38.8%) medical records with PIM identified two medications, five (22.4%) medical records with PIM identified three medications, one (6%) medical record with PIM identified four medications, and one (7.5%) medical record with PIM identified five medications.

Table 2

PIM Identified by the Beers & STOPP Criteria

| No. of PIM | Beers Criteria | STOPP Criteria |
|--|----------------|----------------|
| | No. (%) | No. (%) |
| 1 | 22 (68.8) | 18 (25.4) |
| 2 | 5 (31.3) | 13 (38.8) |
| 3 | | 5 (22.4) |
| 4 | | 1 (6.0) |
| 5 | | 1 (7.5) |
| Total no. of PIM | 32 | 67 |
| No. Males with PIM | 7 (28) | 12 (32.4) |
| No. Females with PIM | 18 (39.7) | 25 (67.6) |
| Total no. of individuals with PIM identified | 25 (39.7) | 37 (58.7) |

Rates of PPO

START Criteria results. Table three summarizes the PPO identified by the musculoskeletal section of the START Criteria. After applying the START Criteria a total of 16 PPO were identified in 11 individuals, 63.6% of PIM were prescribed to females. Six (37.5%) medical records with PPO had one medication identified, five (62.5) medical records with PPO had two medications identified. Omission of Calcium supplements accounted for 37.5% of all PPO and omission of Vitamin D accounted for 31.3% of all PPO (Table 3). The mean age of those identified with a PPO was 78.5 years while the mean age of those without PPO identified was 73.9 years.

Table 3

PPO identified by START Criteria

| No. of PPO | START Criteria |
|-----------------------------------|----------------|
| | No. (%) |
| 1 | 6 (37.5) |
| 2 | 5 (62.5) |
| Total no. of PPO | 16 |
| No. of Males with PPO | 4 (36.4) |
| No. of Females with PPO | 7 (63.3) |
| Total no. of individuals with PPO | 11 (17.5) |

PIM and PPO Identified by Class

PIM classes identified by Beers Criteria. Table four summarizes the most frequent classes of PIM identified by sections of the Beers Criteria. The prescription of NSAIDS, excluding aspirin (ASA), accounted for 68.8% of PIM identified by the criteria, specifically the section independent of diagnosis. The prescription of benzodiazepines in

patients with a history of falls accounted for 3.1% of PIM identified, and was the only medication class identified by the Beers Criteria section that considers diagnosis.

Table 4

PIM Classes: Beers Criteria

| Medication | Total No. (%) |
|---------------------------------------|---------------|
| Drug Class (Independent of Diagnosis) | |
| First Generation Antihistamines | 6 (18.8) |
| NSAID (excluding ASA) | 22 (68.8) |
| Skeletal Muscle Relaxants | 3 (9.4) |
| Drug Class (Considering Diagnosis) | |
| Benzodiazepines with history of fall | 1 (3.1) |
| Total no. of PIM | 32 |

PIM classes identified by STOPP Criteria. Table five summarizes the most frequent classes of PIM identified by the applied sections of the STOPP Criteria. The long-term use of NSAIDs to treat OA accounted for 49.3% of PIM and long-term opiate use to treat mild to moderate pain accounted for 26.9% of PIM identified by the STOPP Criteria. Some medical records triggered PIM in multiple sections of the STOPP Criteria for several medication classes including, NSAIDs, benzodiazepines, opiates, and first generation antihistamines. Those medications were only counted as one PIM, because the different sections identified one PIM, several different times (Table 5*). There were, however, several medical records that had more than one medication from a drug class listed, including NSAIDs and opiates, and those medications were counted separately and included in the total PIM.

Table 5

PIM Classes: STOPP Criteria

| Medication | Total No. (%) |
|---|---------------|
| CNS & Musculoskeletal System | |
| Long-term Benzodiazepines | 8 (11.9) |
| Prolonged use of 1 st Generation Antihistamines | 6 (8.9) |
| Musculoskeletal System | |
| NSAID with moderate-severe Hypertension | 3 (4.5) |
| NSAID with Heart Failure | 1 (1.5) |
| Long-term NSAID use to treat OA | 29 (43.3) |
| Long-term Corticosteroid use to treat OA or Rheumatoid Arthritis (RA) | 2 (2.9) |
| Drugs that Adversely Affect Fallers | |
| Benzodiazepines | 1* |
| 1 st Generation Antihistamines | 1* |
| Analgesic Drugs | |
| Long-term Opiates to treat mild-moderate pain | 18 (26.9) |
| Total no. of PIM | 67 |

*not included in total count of PIM, already identified & counted as PIM in a previous section of criteria

PPO classes identified by START Criteria. Table six summarizes the most frequent classes of PPO identified by the START Criteria musculoskeletal section. The most common potential prescription omissions identified were Calcium and Vitamin D. Omission of Calcium supplements accounted for 37.5% of all PPO and omission of Vitamin D accounted for 31.3% of all PPO.

Table 6

PPO Classes: START Criteria

| Medication | START Criteria |
|------------------------|----------------|
| Musculoskeletal System | |
| DMARD with RA | 1 (6.2) |
| Bisphosphonates | 4 (25) |
| Calcium Supplement | 6 (37.5) |
| Vitamin D Supplement | 5 (31.3) |
| Total no. of PPO | 16 |

Polypharmacy

Table seven summarizes the percentage of the sample with polypharmacy.

Polypharmacy was identified in 73.02% of medical records. Patients were taking an average of 7.4 medications. Table eight summarizes the average number of medications per age range. The age range between 85-89 years had the highest average number of medications per patient (9.8); however, there were only four medical records included in this age range. The largest number of medical records, (25 records, 37.3%) were in the age range of 70-74 years of age.

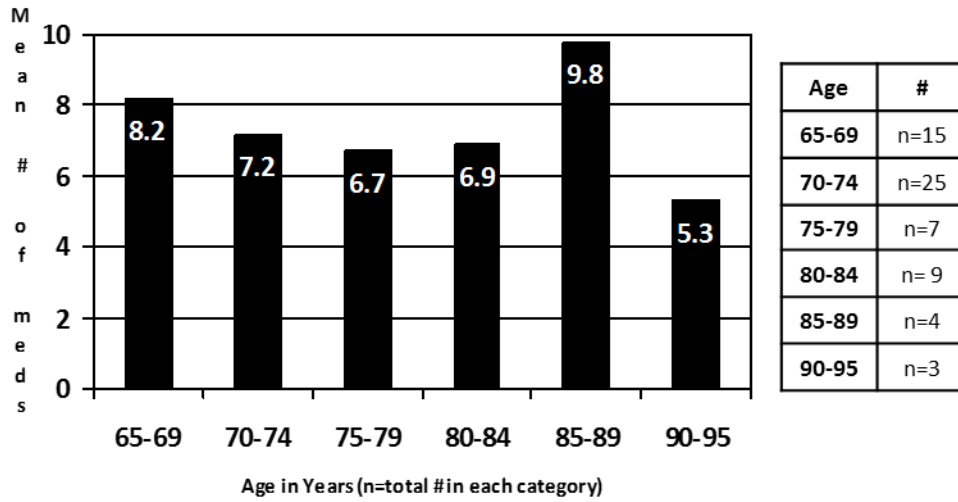
Table 7

Patients Experiencing Polypharmacy

| Characteristic | No. (%) | SD | Range |
|---|---------|------|-------|
| Total no. of Drugs Prescribed | 468 | | |
| Mean no. of Drugs Prescribed per Patient | 7.4 | ±4.7 | 1-25 |
| No. of patients with Polypharmacy (≥ 5 Drugs) | 46 (73) | 4.4 | |

Table 8

Mean Medications Prescribed per Age Range



Length of Time

Table nine summarizes the length of time for the application of each criteria. The sections of the Beers Criteria that were applied took a mean time of 17.38 seconds a medical record. The sections of the STOPP Criteria that were applied took a mean time of 20.15 seconds a medical record. The section of the START Criteria applied took a mean time of 4.02 seconds a medical record.

Table 9

Length of Time for Application per Criteria

| Variable | Beers Criteria | | | STOPP Criteria | | | START Criteria | | |
|----------------------|----------------|------|-------|----------------|------|-------|----------------|------|-------|
| | Mean | SD | Range | Mean | SD | Range | Mean | SD | Range |
| Mean time in seconds | 17.4 | ±7.1 | 8-46 | 20.2 | ±8.9 | 8-53 | 4 | ±1.7 | 2-10 |

Chapter 5: Summary

Discussion Overview

This study showed that the use of medication screening tools, specifically sections of both the Beers and STOPP/START Criteria, identified PIM and PPOs with a retrospective chart review. There is little to no research conducted with the application of only selected sections of both criteria, specifically in a musculoskeletal practice, therefore, the results of this study are somewhat unique. Several European studies conducted in a variety of settings have compared the application of the entire Beers and STOPP/START Criteria and the rate of PIM. Due to the similar content of other studies and the present study, results can be compared while being mindful the differences in methodology and design.

Discussion of Sample Characteristics

Considering the setting for data collection, it was anticipated that there would be a high incidence of musculoskeletal conditions including OA, OP, falls, and fractures. There was a high incidence, as expected, of OA with all but one medical record having a documented past medical history of OA. It was surprising there was not a higher incidence of OP, with only 15.9% of the medical records reported OP in the past medical history. The reason for this low incidence is unknown. Additionally, the low incidence of hospitalizations or falls reported in patients was surprising. Hospitalizations have been linked as a possible ADR caused by PIM (Yayla et al, 2013). The ability to detect PIM may have been hindered with the low rates of reported hospitalizations and falls. The sections of criteria related to patients with a history of falls were not applied to the medical records that did not report a recent fall. If a patient had a fall that was not

documented or reported, they could be at an unknown risk for PIM that is not being assessed.

Discussion of Rates of PIM

Based on review of current literature it was anticipated the STOPP Criteria would identify more PIM than the Beers Criteria. Ryan and colleagues (2009) reported in a study conducted in an Irish primary care setting that the Beers Criteria identified PIM in 18.3% of patients and the STOPP Criteria identified PIM in 21.4% of patients. Gallagher and O'Mahony (2008) reported in an Irish acute care setting that the Beers Criteria identified PIM in 25% of patients while the STOPP Criteria identified PIM in 35% of patients. Ubeda and colleagues (2012) conducted a study in long-term care facilities in Spain comparing the Beers and STOPP/START Criteria and reported the Beers Criteria identified PIM in 25% while STOPP identified PIM in 48% of patients. A study done by Vishwas and colleagues (2012) reported different results from previously mentioned studies stating the Beers Criteria identified PIM in 24.6% of patients and STOPP only identified PIM in 13.3%. The present study results show the rate of PIM identified in a musculoskeletal specialty practice in the Midwest applying specific sections of the Beers Criteria is 39.7% and specific sections of the STOPP Criteria is 58.7%.

The Beers and STOPP criteria have many similar PIM recommendations; however, there are several differences that may impact the number of PIM identified by each. The organization of the criteria may impact the number of PIM identified. The STOPP Criteria is organized by body system and considers specific patient clinical data, duplicate drug classes, and PPO while the Beers Criteria has 3 lists of medications to 1)

avoid considering diagnosis, 2) avoid independent of diagnosis, 3) use with caution and does not address PPO.

Both criteria overall identified NSAIDs, antihistamines, and benzodiazepines as PIM. The Beers Criteria does not identify Aspirin ≥ 325 mg daily to be to a potentially inappropriate NSAID or opiates to be PIM in the sections applied. The STOPP Criteria does not consider skeletal muscle relaxants as a PIM in the sections applied. A benefit to applying the STOPP Criteria is the patient specific information in each recommendation; however, this does bring some difficulty in a retrospective study. One difficulty is in determining if OA being treated with NSAIDS is mild to moderate. Based on review of current literature it was anticipated the STOPP Criteria would identify more PIM than the Beers Criteria. Ryan and colleagues (2009) reported in a study conducted in an Irish primary care setting that the Beers Criteria identified PIM in 18.3% of patients and the STOPP Criteria identified PIM in 21.4% of patients. The results of the present study show the rate of PIM identified in a musculoskeletal specialty practice in the Midwest applying specific sections of the Beers Criteria is 39.7% and using sections of the STOPP Criteria is 58.7%. These results are similar to the previously mentioned results of other studies in that the rate of PIM was higher with application of the STOPP Criteria than with the Beers Criteria.

Discussion of rates of PPO

One benefit of applying the STOPP/START Criteria is the recognition of PPO by START, which the Beers Criteria does not consider. Ryan and colleagues (2009) reported in a study conducted in an Irish primary care setting that PPOs were identified in 22.7% of patients with a significantly higher incidence in females. The results of the

present study showed the rate of PPO identified in a musculoskeletal specialty practice in the Midwest using a section of the START Criteria was 17.5% and the incidence was higher in females (63.3%). This result could be due, at least partially, because there were more females than males in the total sample.

Discussion of PIM and PPO Identified by Class

Discussion of PIM classes identified by Beers Criteria. Based on review of current literature Ryan and colleagues (2009) found that with the Beers Criteria, the identification of benzodiazepines accounted for 31.9% of PIM. Ubeda and colleagues (2012) reported the two most commonly identified classes of PIM include NSAIDs and benzodiazepines. According to the present study results the most common medication classes identified by the Beers Criteria were NSAIDs (68.8%).

Discussion of PIM classes identified by STOPP Criteria. Based on review of current literature and basic knowledge about the musculoskeletal setting, the most anticipated classes of PIM included NSAIDs, opiates, and benzodiazepines. Dalleur and colleagues (2012) reported two of the most common PIM classes identified by the STOPP Criteria were benzodiazepines and opiates. In an Australian hospital setting Shahezwan and colleagues (2012) reported the most common PIM identified by the STOPP criteria were long-term opiates and benzodiazepines prescribed to elderly patients with a history of falls. Cahir and colleagues (2010) reported that the second and third most frequently reported PIM classes were, in order, NSAIDs for > 3 months and benzodiazepines. According to the present study results the most common medication classes identified by the STOPP Criteria were long-term NSAID use to treat OA (43.3%), long-term opiates (26.9%), and long-term benzodiazepines (11.9%).

Long-term NSAID use may be associated with gastrointestinal problems, heart failure exacerbation, and chronic renal failure (Cahir et al, 2013). Benzodiazepine use in the geriatric population is associated with increased risk for falls, fractures, respiratory depression, impaired cognitive function, drowsiness, and dependence (Cahir et al, 2010; Shahezwan et al, 2012; Berryman et al, 2012). Opiate use in the geriatric population can cause drowsiness, respiratory depression, hypotension, impaired balance leading to increased risk for falls and fractures (Shahezwan et al, 2012).

Discussion of PPO classes identified by START Criteria. Dalleur and colleagues (2012) and Ubeda and colleagues (2012) found that the most common PPO in hospitalized elderly patients were the underuse of Calcium and Vitamin D supplementation. According to the present study the most common PPO classes identified by the START Criteria were Calcium supplements (37.5%) and Vitamin D supplements (31.3%). As previously mentioned, there was a low incidence of patients with OP in this study. This low incidence might negatively affect the identification of the PPO of bisphosphonates. This could negatively impact patient outcomes considering, Dalleur and colleagues (2012) reported that fall-induced osteoporotic fractures were the most common hospital admission diagnosis related to inappropriate prescribing.

Discussion of Polypharmacy

Due to the advanced age of the sample and multiple chronic diseases it was anticipated that a large number of patients would have polypharmacy. According to the present study 46 patients (73%) had polypharmacy. The mean number of drugs prescribed per patient was 7.4 medications with a range of 1-25 medications. When considering the average number of medications per age range, it was anticipated that as

age increased, the average number of medications would also increase as was reported in a study conducted by Ryan and colleagues (2009). In this study, however, this was not the case. This unexpected finding could be a result of the unequal number of medical records in each age range (Table 8).

Discussion of Application Length of Time

Only sections of each criteria were applied, for this reason it was difficult to predict the length of time for application of each criteria. According to the present study the sections of the Beers Criteria took a mean time of 17.4 seconds to apply to a medical record, 2.8 seconds less on average than the sections of the STOPP Criteria. The section of the START Criteria took an average of 4 seconds per medical record. In current literature, no studies were found that compared the application time of the Beers Criteria and the STOPP/START Criteria in their entirety or sections. Literature states that an individual familiar with the STOPP Criteria can apply it in its entirety in 3 minutes and the START criteria within 1 minute. There is a short learning curve while one becomes familiar with the criteria (Gallagher et al, 2011).

Limitations

There were several limitations to this study. There is a lack of generalizability of results related to the small sample size and application in one specialty care practice in the Midwest. Due to the retrospective design of the study there was a limited ability to consider prescribers opinions and clinical judgement. Medications could have been identified as PIM that were clinically appropriate. Application of only particular sections, rather than the entire STOPP/START Criteria or Beers Criteria is a potential limitation that may affect validity and reliability of the criteria. However, based on the

specialty practice where data was collected, a selection of criteria sections that match the specialty practice focus seemed appropriate for study. The low incidence of documented hospital stays, recent falls, kidney function, and history of ulcers resulted in certain sections of both criteria not being applicable to medical records. This may cause a false decrease in the number of PIM identified by each criteria.

Implications for Practice

Descriptive statistics confirmed that sections of the STOPP Criteria identified more PIM than sections of the Beers Criteria in the same sample. However, at least in the sections applied the Beers Criteria may be faster to apply to a medical record. The limitation of only applying sections of each criteria impacts the implications for practice because a provider would likely apply the entire criteria to a medical record.

Recommendations for Future Research

Future research recommendations relating to the study of the Beers and STOPP/START Criteria include studies with larger sample sizes, a primary care setting in the U.S., and the application of both criteria in their entirety. A different study design should be conducted to assist in the application of the criteria in conjunction with clinical judgement to see how the criteria function in practice. Both criteria need regular updates to remain relevant for future study.

Conclusion

In conclusion, the problem of avoiding PIM and preventing potential ADR in the geriatric population is complex. However, prevention of PIM and potential ADR may be achieved with a medication screening tool. Medication screening tools can assist with

education about PIM and a reminder to regularly evaluate medications prescribed to the geriatric population.

References

- Administration on Aging U.S. Department of Health and Human Services (2011). A profile of older americans: 2011. Retrieved on March 27, 2013, from: http://www.aoa.gov/Aging_Statistics/Profile/2011/docs/2011profile.pdf.
- American Geriatric Society (2012). American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. Retrieved on April 4, 2013, from: http://www.americangeriatrics.org/files/documents/beers/2012BeersCriteria_JAGS.pdf.
- American Pharmacists Association (2012). Nonprescription antihistamines: Geriatric considerations. Retrieved July 14, 2013 from: <http://www.pharmacist.com/nonprescription-antihistamines-geriatric-considerations>.
- American Psychology Association (1998). Older adults' health and age-related changes: Reality versus myth [Brochure]. Washington, DC: n.p.
- Barnsteiner, J. (2008). Medication reconciliation. In R.G. Hughes (Ed.), *Patient safety and quality: an evidence-based handbook for nurses*. Rockville (MD): Agency for Healthcare Research and Quality.
- Barry, P., Gallagher, P., Ryan, C., O'Mahony, D. (2007). START (screening tool to alert doctors to the right treatment) an evidence-based screening tool to detect prescribing omissions in elderly patients. *Age and Aging*, 36, 632-638.
- Beer, C., Hyde, Z., Almeida, O. (2011). Quality use of medicines and health outcomes amount a cohort of community dwelling older men: An observational study. *British Journal of Clinical Pharmacology*, 71(4), 592-599.
- Beers, M. (1997). Explicit criteria for determining potentially inappropriate medication use by the elderly. An update. *Archives of Internal Medicine*, 157(14), 1531-1536.
- Beers, M., Ouslander, J., Rollinger, I., Reuben, D., Brooks, J., Beck, J., (1991). Explicit criteria for determining inappropriate medication use in nursing home residents. *UCLA Division of Geriatric Medicine, Archives of Internal Medicine*, 151(9), 1825-1832.
- Berryman, S., Jennings, J., Ragsdale, S., Lofton, T., Huff, D., Rooker, J., (2012). Beers Criteria for potentially inappropriate medication use in older adults. *Med-Surg Nursing*, 21(3), 129-133.
- Bloomsbury Business Library (2007). Leavitt's diamond. A & C Black Publishers Ltd.

- Bradley, M., Fahey, T., Cahir, C., Bennett, K., O'Reilly, D., Parsons, C., Hughes, C. (2012). Potentially inappropriate prescribing and cost outcomes for older people: A cross-sectional study using the northern Ireland enhanced prescribing database. *European Journal of Clinical Pharmacology*, DOI 10.1007/s00228-012-1249-y.
- Brahmbhatt, M., Palla, K., Kossifologos, A., Mitchell, D., Lee, T. (2013). Appropriateness of medication prescribing using the STOPP/START Criteria in veterans receiving home-based primary care. *The Consultant Pharmacist*, 6(28), 361-369.
- Brouwer, B., Olney, S. (2004). Aging skeletal muscle and the impact of resistance exercise. *Physiotherapy Canada*, 56(2), 80-87.
- Cahir, C., Fahey, T., Teeling, M., Teljeur, C., Feely, J., Bennett, K. (2010). Potentially Inappropriate prescribing and cost outcomes for older people: A national population study. *British Journal of Clinical Pharmacology*, 69(5), 543-552.
- Campanelli, C. (2012). American Geriatric Society updated Beers Criteria for potentially inappropriate medication use in older adults. *Journal of the American Geriatric Society*, 60(4), 616-631.
- Centers for Medicare & Medicaid Services (2012). Chronic conditions among Medicare beneficiaries. Retrieved March 31, 2013 from: <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/Downloads/2012Chartbook.pdf>.
- Centers for Disease Control and Prevention (2012). Falls among older adults: An overview. Retrieved March 31, 2013 from: <http://www.cdc.gov/homeandrecreationalafety/falls/adultfalls.html>.
- Centers for Disease Control and Prevention (2010). Prevalence of doctor-diagnosed arthritis and arthritis attributable activity limitation: United States, 2007-2009. *Morbidity and Mortality Weekly Report*, 59(39), 1261-1265.
- Cherubini, A., Corsonello, A., Lattanzio, F. (2012). Under prescription of beneficial medicines in older people: Causes, consequences, and prevention. *Drugs Aging*, 29(6), 463-475.
- Clyne, B., Bradley, M., Smith, S., Hughes, C., Motterlini, N., Clear, D., McDonnell, R., Williams, D., Fahey, T. (2013). Effectiveness of medicines review with web-based pharmaceutical treatment algorithms in reducing potentially inappropriate prescribing in older people in primary care: A cluster randomized trial (OPTI-SCRIPT study protocol). *Trials*, 14(72).

- Cockburn, J. (1997). Prescribing behaviour in clinical practice: patients' expectations and doctors' perceptions of patients' expectations-a questionnaire study. *British Medical Journal*, 315, 520.
- Coggins, M. (2013). Antihistamine Risks. *Aging Well*, 6(2). Retrieved on July 14, 2013 from: <http://www.todaysgeriatricmedicine.com/archive/0313p6.shtml>.
- Dalleur O, Boland B, Spinewine A. (2012) 2012 Updated Beer's criteria: Greater applicability to Europe? *Journal of American Geriatrics Society*, 60, 2188-2189.
- Dovjak, P. (2012). Tools in polypharmacy: current evidence from observational and controlled studies. *Zeitschrift fur Gerontologie und Geriatrie*, 6(45), 468-472.
- Ejaz, P., Bhojani, K., Joshi, V. (2004). NSAIDs and kidney. *Journal of the Association of Physicians of India*. 56, 632-640.
- Federal Interagency Forum on Aging Related Statistics (2010). Older americans 2010: Key indicators of well-being. Retrieved February 24, 2013, from: http://www.agingstats.gov/Main_Site/Data/2010_Documents/Population.aspx.
- Feinberg, J., Simonson, W. (2005). Medication-related problems in the elderly: Defining the issues and identifying solutions. *Drugs Aging*. 22, 559-569.
- Fick, D., Semla, T. (2012). 2012 American Geriatrics Society Beers criteria: New year, new criteria , new perspective. *Journal of American Geriatric Society*, Retrieved April 4, 2013, from: http://www.americangeriatrics.org/files/documents/beers/Perspective_JAGS.pdf.
- Fick, D., Cooper, J., Wade, W., Waller, J., Maclean, J., Beers, M. (2003). Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. *Archives of Internal Medicine*. 163(22), 2716-2724.
- Gallagher, P., Baeyens, J., Topinkova, E., Madlova, P., Cherubini, A., Gasperini, B., Cruz-Jentoft, A., Montero, B., Lang, P., Michel, J., O'Mahony, D. (2009). Inter-rater reliability of STOPP (Screening Tool of Older Persons' Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment) criteria amongst physicians in six European countries. *Age and Aging*, 10, 603-606.
- Gallagher, P., O'Connor, M., O'Mahony, D. (2011). Prevention of potentially inappropriate prescribing for elderly patients: A randomized control trial using STOPP/START criteria. *Clinical Pharmacology and Therapeutics*, 89(6), 845-854.

- Gallagher, P., O'Mahony, D. (2008). STOPP (screening tool of older persons' potentially inappropriate prescriptions): Application to acutely ill elderly patients and comparison with beer's criteria. *Age and Ageing*. 37, 673-679.
- Gallagher, P., Ryan, C., Byrne, S., Kennedy, J., O'Mahony, D. (2007). STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment. Consensus validation. *International Journal of Clinical Pharmacology and Therapeutics*, 46(2),72-83.
- Gillespie, U., Alassaad, A., Hammarlund-Udenaes, M., Morlin, C., Henrohn, D., Bertilsson, M., Melhus, H. (2013). Effects of pharmacists' interventions on appropriateness of prescribing and evaluation of the instruments' (MAI, STOPP and STARTs') ability to predict hospitalization--analyses from a randomized controlled trial. *Public Library of Science*, 8(5).
- Hajjar, E., Cafiero, A., Hanlon, J. (2007) Polypharmacy in elderly patients. *The American Journal of Geriatric Pharmacotherapy*, 5(4), 345-351.
- Hamilton, H., Gallagher, P., O'Mahony, D. (2009). Inappropriate prescribing and adverse drug events in older people. *Biomedical Central Geriatrics* 9(5).
- Hamilton, H., Gallagher, P., Ryan, C., Byrne, S., O'Mahony, D. (2010). Potentially inappropriate medications defined by STOPP criteria and the risk of adverse drug events in older hospitalized patients. *Archives of Internal Medicine*, 171(11), 1013-1019.
- Hanlon, J., Schmader, K., Kornkowsky, M. (1997). Adverse drug events in high risk older outpatients. *Journal of American Geriatric Society*, 45, 945-948.
- Hegeman, J., van den Bemt, J., Duysens, J., Limbeek, J. (2009) NSAIDs and the risk of accidental falls in the elderly a systematic review. *Drug Safety*. 32(6), 489-498.
- Hill-Taylor, B., Sketris, I., Hayden, J., Byrne, S., O'Sullivan, D., Christie, R. (2013). Application of the STOPP/START Criteria: A systematic review of the prevalence of potentially inappropriate prescribing in older adults, and evidence of clinical, humanistic and economic impact. *Journal of Clinical Pharmacology Therapy*, DOI 10.1111/jcpt.12059.
- IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.
- International Osteoporosis Foundation (2013). Facts and statistics. Retrieved March 31, 2013, from: <http://www.iofbonehealth.org/facts-statistics#category-14>.
- Jano, E., Aparasu, R. (2007). Healthcare outcomes associated with Beer's criteria: A systematic review. *The Annals of Pharmacotherapy*, 41(3), 438-447.

- Kaufman, D., Kelly, J., Rosenberg, L., Anderson, T., Mitchell, A. (2002) Recent patterns of medication use in the ambulatory adult population in the United States: The Slone survey. *Journal of American Medical Association*, 287(3), 337-344.
- Kiebazk, G., Beinart, G., Perser, K., Ambrose, C., Siff, S., Heggeness, M. (2002). Under-treatment of osteoporosis in men with hip fracture. *Archive of Internal Medicine*, 162, 2217-2222.
- Klotz, U. (2009). Pharmacokinetics and drug metabolism in the elderly. *Drug Metabolism Reviews*, 41(2), 67-76.
- Kojima, T., Akishita, M., Nakamura, T., Nomura, K., Ogawa, S., Iijima, K., Eto, M., Ouchi, Y. (2010) Polypharmacy as a risk for fall occurrence in geriatric outpatients. *Geriatrics & Gerontology International*. 12, 425-430.
- Lang, P., Hasso, Y., Belmin, J., Payot, I., Baeyens, J., Vogt-Ferrier, N., Gallagher, P., O'Mahony, D., Michel, J. (2009). STOPP-START: Adaptation en langue française d'un outil de détection de la prescription médicamenteuse inappropriée chez la personne âgée. *Rev can sante publique*, 100(6), 426-431.
- Marcum, Z., Hanlon, J. (2012). Commentary on the new American Geriatric Society Beer's Criteria for potentially inappropriate medication use in older adults. *American Journal of Geriatric Pharmacotherapy*, 10(2), 151-159.
- NHS Cumbria Medicines Management Team (2013). Clinical medication review: a practice guide. Retrieved July 16, 2013 from: <http://www.cumbria.nhs.uk/ProfessionalZone/MedicinesManagement/Guidelines/MedicationReview-PracticeGuide2011.pdf>.
- O'Mahony, D. (2012) Medication errors & STOPP/START criteria [PDF document]. Retrieved from http://www.ema.europa.eu/docs/en_GB/document_library/Presentation/2012/04/WC500125149.pdf.
- O'Mahony, D., Gallagher, P. (2008) Inappropriate prescribing in the older population: Need for new criteria. *Age and Aging* 37, 138-141.
- O'Mahony, D., Gallagher, P., Ryan, C., Byrne, S., Hamilton, H., Barry, P., O'Connor, M., Kennedy, J. (2010). STOPP & START criteria: A new approach to detecting potentially inappropriate prescribing in old age. *European Geriatric Medicine*, 1, 45-51.

- Onatade, R., Auyeung, V., Scutt, G., Fernando, J. (2013). Potentially inappropriate prescribing in patients on admission and discharge from an older peoples' unit of an acute UK hospital. *Drugs Aging*, DOI 10.1007/s40266-013-0097-5.
- Opondo, D., Eslami, S., Visscher, S., Rooij, S., Verheij, R., Kroevaar, J., Abu-Hanna, A. (2012). Inappropriateness of medication prescriptions to elderly patients in primary care setting: A systematic review. *Public Library of Science*. 7(8), 1-10.
- Page, J. (2000). Consumption of NSAIDs and the development of congestive heart failure in elderly patients: An underrecognized public health problem. *Archives of Internal Medicine*, 160(6), 777-784.
- Parsons, C., Johnston, S., Mathie, E., Baron, N., Machen, I., Amador, S., Goodman, C. (2012). Potentially inappropriate prescribing in older people with dementia in care homes: A retrospective analysis. *Drugs & Aging*, 29(2), 143-155.
- Perry, M. (2011). The problem of polypharmacy in the elderly. *Nurse Prescribing*, 9(7), 347-349.
- Pham, C., Dickman, R. (2007). Minimizing adverse drug events in older patients. *American Family Physician*, 76, 1837-1844.
- Pretorius, R., Gataric, G., Swedlund, S., Miller, J. (2013). Reducing the risk of adverse drug events in older adults. *American Family Physician*, 87(5), 331-336.
- Ramaswamy, R., Maio, V., Diamon, J., Talati, A., Hartmann, C., Arenson, C., Roehl, B. (2010) Potentially inappropriate prescribing in elderly: Assessing doctor knowledge, confidence, and barriers. *Journal of Evaluation in Clinical Practice*, 17(6), 1153-1159.
- Resnick, B., Pacala J. (2012). 2012 Beers Criteria. *Journal of American Geriatric Society*. Retrieved on April 4, 2013 from: http://www.americangeriatrics.org/files/documents/beers/Editorial_JAGS.pdf.
- Roberts, A., Hopp, T., Sorensen, E., Benrimoj, S., Chen, T., Herborg, H., Williams, K., Aslani, P. (2003). Understanding practice change in community pharmacy: A qualitative research instrument based on organisational theory. *Pharmacy World Science*, 25(5); 227-234.
- Rochon, P., Gurwitz, J. (1997). Optimising drug treatment for elderly people: the prescribing cascade. *British Medical Journal*, 315, 1096-1099.
- Rosen, A., Karter, A., Liu, J., Selby, J., Schneider, E. (2004) Use of angiotensin-converting enzyme inhibitors and angiotensin receptor blockers in high-risk

- clinical and ethnic groups with diabetes. *Journal of General Internal Medicine*, 19, 669-675.
- Ryan, C. (2011). Screening tool of older persons' prescriptions (STOPP) and screening tool to alert doctors to right treatment (START) criteria. [PDF document]. Retrieved from <http://www.farmaactueel.nl/webcasts/extern/ESCP2011n/PDF/Ryan.pdf>.
- Ryan, C., O'Mahony, D., Kennedy, J., Weedle, P., Byrne, S. (2009) Potentially inappropriate prescribing in an Irish elderly population in primary care. *British Journal of Clinical Pharmacology*, 68(6), 936-947.
- Shahezwan, M., Wahab, A., Nyfort-Hansen, K., Kowalski, S. (2012). Inappropriate prescribing in hospitalised Australian elderly as determined by the STOPP criteria. *International Journal of Clinical Pharmacology*, 34, 855-862.
- Sloane, P., Gruber-Baldini, A., Zimmerman, S., Roth, M., Watson, L., Boustant, M. (2004). Medication under-treatment in assisted living settings. *Archives of Internal Medicine*, 164, 2031-2037.
- Spinewine, A., Schmader, K., Barber, N., Hughes, C., Lapane, K., Swine, L., Hanlon, J., (2007). Appropriate prescribing in elderly people: How well can it be measured and optimized? *The Lancet*, 370, 173-184.
- Steinman, M. (2007). Polypharmacy and the balance of medication benefits and risks. *American Journal of Geriatric Pharmacotherapy*, 5(4), 314-315.
- Taziaux, P. Franck, J., Ludovicy, R., Albert, A. (1996). A study of general practitioners' prescribing behaviour to the elderly in Wallonia, Belgium. *European Journal of Public Health*, 6(1), 49-57.
- Therapeutic Research Center (2011). STARTing and STOPPing medications in the elderly. *Prescriber's Letter*; Sept 2011, 1-14.
- Trivedi, D., Doll, R., Khaw, K., (2003) Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. *British Medical Journal*, 326:469.
- Ubeda, A., Ferrandiz, L., Maicas, N., Gomez, C., Bonet, M., Peris, J. (2012). Potentially inappropriate prescribing in institutionalised older patients in Spain: The STOPP-START criteria compared with the Beers criteria. *Pharmacy Practice*, 10(2), 83-91.
- U.S. General Accounting Office (1995). Prescription drugs and the elderly. *AO/HEHS-95-152*. Washington, DC: U.S. General Accounting Office.

- Vieira de Lima, T., Garbin C., Garbin, C., Garbin, A., Sumida, D., Saliba, O. (2013). Potentially inappropriate medications used by the elderly: Prevalence and risk factors in Brazilian care homes. *Biomedical Central Geriatrics*, 13(52).
- Vishwas, H., Harugeri, A., Parthasarathi, G., Ramesh, M. (2011). Potentially inappropriate medication use in indian elderly: Comparison of Beers' criteria and Screening Tool of Older Persons' potentially inappropriate Prescriptions. *Geriatric Gerontology International*, 12, 506-514.
- Werder, S., Preskorn, S. (2003). Managing polypharmacy: Walking the fine line between help and harm. *Current Psychiatry*, 2(2), 24-36.
- Whitaker, J. (2011). Preventing falls in older people: Assessment and interventions. *Nursing Standard*, 25(52), 50-55.
- Whitaker, M., Guo, J., Kehoe, T., Benson, G. (2012). Bisphosphonates for osteoporosis: Where do we go from here? *New England Journal of Medicine* 366, 2048-2051.
- Williams, C. (2002). Using medications appropriately in older adults. *American Family Physician*, 66(10), 1917-1924.
- Windsant-van den Tweel, V., Verduijn, M., Derijks, H., van Marum, R. (2012). Detection of inappropriate medication use in the elderly: Will the STOPP and START criteria become the new Dutch standards? *Ned Tijdschr Geneesk*, 156(40).
- Yayla, M., Bilge, U., Binen, E., Keskin, A. (2013). The use of START/STOPP Criteria for elderly patients in primary care. *The Scientific World Journal*, DOI 10.1155/2013/165873.
- Ziere, G., Dieleman, J., Hofman, A., Pols, H., Van der Cammen, T., Stricker, B. (2005). Polypharmacy and falls in the middle age and elderly population. *British Journal of Clinical Pharmacology*, 61(2), 218-223.

Appendix A

STOPP Criteria: (O'Mahony et al, 2010)

Screening Tool of Older People's potentially inappropriate Prescriptions

The following drug prescriptions are potentially inappropriate in persons aged 65 years of age.

A. Central Nervous System & Psychotropic Drugs

1. Tricyclic antidepressants (TCAs) with dementia
2. TCAs with glaucoma
3. TCAs with cardiac conduction abnormalities
4. TCAs with constipation
5. TCAs with an opiate or calcium channel blocker
6. TCAs with prostatism or prior history of urinary retention
7. Long-term (>1month) long acting benzodiazepines
8. Long-term (>1month) neuroleptics as long-term hypnotics
9. Long-term (>1month) neuroleptics in those with Parkinsons
10. Phenothiazines in patients with epilepsy
11. Anticholinergics to treat extrapyramidal side effects of neuroleptic medications
12. Selective serotonin re-uptake inhibitors (SSRIs) with a history of clinically significant hyponatraemia
13. Prolonged use (>1week) of first generation antihistamines

B. Musculoskeletal System Drugs

1. Non-steroidal anti-inflammatory drug (NSAID) with history of peptic ulcer disease or gastrointestinal bleeding, unless with concurrent histamine H2 receptor antagonist, PPI, or misoprostol
2. NSAID with moderate-severe hypertension (moderate: 160/100-179/100; severe 180/110)
3. NSAID with heart failure
4. Long-term use of NSAID (>3months) for symptoms relief of mild osteoarthritis
5. Warfarin and NSAID together
6. NSAID with chronic renal failure (Serum Cr >150, GFR 20-50 ml/min)
7. Long term corticosteroid use (>3months) as monotherapy for rheumatoid arthritis or osteoarthritis
8. Long term NSAID or colchicine for chronic treatment of gout where there is no contraindication to allopurinol.

C. Drugs that Adversely Affect Fallers

1. Benzodiazepines
2. Neuroleptic drugs
3. First-generation antihistamines
4. Vasodilator drugs with persistent postural hypotension (recurrent >20mmHg drop in systolic BP)
5. Long-term opiates in those with recurrent falls

D. Analgesic Drugs

1. Use of long-term powerful opiates as first line therapy for mild to moderate pain.
2. Regular opiates for >2weeks in those with chronic constipation without concurrent use of laxatives
3. Long-term opiates in those with dementia unless indicated for palliative care or management of moderate-severe chronic pain syndrome

START Criteria:

Screening Tool to Alert doctors to Right i.e. appropriate, indicated Treatment. These medications should be considered for people 65 years of age with the following conditions, where no contraindication to prescription exists.

A. Musculoskeletal System Drugs

1. Disease-modifying antirheumatic drug with active moderate-severe rheumatoid disease lasting >12 weeks.
2. Bisphosphonates in patients taking maintenance corticosteroid therapy
3. Calcium supplement in patients with known osteoporosis (previous fragility fracture, acquired dorsal kyphosis)
4. Vitamin D in patients with known osteoporosis (previous fragility fracture, acquired dorsal kyphosis)

Appendix B

Beer's Criteria (American Geriatric Society, 2012)

Organ System/Therapeutic Category/Drug(s)-Independent of Diagnosis

First Generation antihistamines (as a single agent or part of combination products)

- Brompheniramine
- Carbinoxamine
- Chlorpheniramine
- Clemastine
- Cyproheptadine
- Dexbrompheniramine
- Dexchlorpheniramine
- Diphenhydramine (oral)
- Doxylamine
- Hydroxyzine
- Promethazine
- Triprolidine

Pain Medications

Meperidine

Non-COX-selective NSAIDs, oral

- Aspirin >325mg/day
- Diclofenac (oral)
- Diflunisal
- Etodolac
- Fenoprofen
- Ibuprofen
- Ketoprofen
- Meclofenamate
- Mefenamic acid
- Meloxicam
- Nabumetone
- Naproxen
- Oxaprozin
- Piroxicam
- Sulindac
- Tolmetin

Indomethacin

Ketorolac (includes parenteral)

Pentazocine

Skeletal Muscle Relaxants

- Carisoprodol
- Chlorzoxazone
- Cyclobenzaprine
- Metaxalone
- Methocarbamol
- Orphenadrine

Disease or Syndrome; Drugs-Considering Diagnosis

History of falls or fractures

Anticonvulsants

Antipsychotics

Benzodiazepines

Non-Benzodiazepine hypnotics

-Eszopiclone

-Zaleplon

-Zolpidem

TCAs/SSRIs

History of gastric or duodenal ulcers

-Aspirin (>325mg/)

-Non-COX-2 selective NSAIDs

Chronic kidney disease stages IV and V

-NAIDs

-Triamterene (alone or in combination)

Appendix C

Demographic Data Collection Tool

Patient Identifier #: 1-63

Age:

Gender:

Race/Ethnicity:

Allergies:

Insurance provider:

Past Medical History (exclude terminally ill; include those with OP, OA, rheumatoid arthritis (RA), gout, atrial fibrillation, hypertension, congestive heart failure, peptic ulcer disease, gastrointestinal bleed, renal failure, chronic pain, Parkinson's, anxiety, depression, insomnia, or seasonal allergies):

Heart rate:

BP: (no hypertension, moderate hypertension-160-179/100, severe hypertension-180/110)

Hospitalizations in last year:

History of falls in last 3 months:

Current Medications (including prescription and OTC/supplements):