Review of Impact of Medications on Older Adult Fall and Fire Risk

Final Report by:

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Foreword

Fifty-two million Americans aged 65 or older make up 16% of the total US population, yet this age bracket experiences disproportionate injuries and deaths from fire and falls. Falls are the leading cause of death from unintentional injuries for older adults. The risk factors associated with aging populations are similar for fires and falls, making it critical to educate older adults on adopting prevention and response behaviors. The NFPA Remembering When™ program is a fire and fall prevention program for older adults developed by NFPA and the Centers for Disease Control and Prevention (CDC). This program is designed to help older adults live safely at home for as long as possible. There are sixteen key messages, eight related to fire prevention and eight related to fall prevention.

The overall goal of this project is to identify the relationship between medication use and fall/fire risk of older adults and generalize findings to inform message development.

The project comprised of six tasks: a literature review, healthcare landscape analysis, an interim report, documentation of case studies, a list of current fall and fire prevention programs and a final report. The purpose of the literature review is to identify medication use in age groups 50-64 and 65+ and the role of medications can have on falls and fire risks. The healthcare landscape analysis consisted of the characterization of the healthcare payer landscape as it relates to older adults (65+), medications, and falls by reviewing and analyzing available information. The interim report summarizes the information provided in the previous two tasks. The purpose of the case study in task 4 is to document three general case studies on the medication and risk factors for falls and fires. Lastly, current fall and fire prevention/intervention programs and organizations, along with their respective objectives are documented. A final report summarized these tasks into this final report.

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All NFPA codes and standards can be viewed online for free.

NFPA’s membership totals more than 65,000 individuals around the world.

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EXECUTIVE SUMMARY

The goal of this research was to identify associations between medication use and fall and fire risks in older adults. The outcome of this research will be utilized to inform messaging for older adult fall and fire risk reduction programs, such as the Remembering When program. To achieve the research goal, the research team focused on four objectives. The first objective was to conduct a literature review on medication use and its relationship to fall and fire risks in age groups 50-64 and 65 and older. The second objective was to characterize the healthcare payer landscape related to older adults (65 and older), medications, and falls and fires by reviewing and analyzing available data. The third objective was to investigate case studies related to medications and risk factors for falls and fires, and the fourth objective was to review and present a summary of fall and fire prevention programs.

The literature review produced studies which identified associations between fall risk and medication use. Perhaps most comprehensive and useful for the purposes of assessing medication use and fall risk is the Beers Criteria (2019), which provides evidence-based recommendations to older adults and medical providers to reduce potentially harmful medication outcomes. The Beers Criteria (2019) indicates that antipsychotics, benzodiazepines and nonbenzodiazepines (e.g., insomnia drugs or z-drugs) cause an increased risk of cognitive impairment, falls, and fractures in older adults. Older adults with fall and fracture history are advised to avoid antiepileptics, antipsychotics, benzodiazepines, nonbenzodiazepine insomnia medications, antidepressants, and opioids. Moreover, older adults taking three or more drugs classified as antidepressants, antipsychotics, antiepileptics, benzodiazepines, nonbenzodiazepines, and opioids are indicated to have an increased fall risk.

Literature on medication use and fire risk is not as plentiful, and of the studies that have been performed, many are not specific to older adults or are limited in the types of medications assessed. One study, not specific to older adults, showed that 76% of decedents had alcohol and/or drugs in their system, and the most frequently found drugs were antidepressants, benzodiazepines, non-opioid analgesics, hypnotics, and opioids. Another study, not specific to older adults, found that 46% of decedents tested positive for drugs and detected drugs included pain relievers and benzodiazepines. In one other study not specific to older adults, hypnotic/sedative drugs were found in 29% of decedents and antidepressants were found in 10% of decedents. In general, studies suggest a relationship between alcohol and medication use and increased fire risk; however, more research is needed to identify which specific drug classes have the most significant association in the older adult population.

Regarding the healthcare payer landscape, several Medicare programs and services were identified which target older adult fall prevention and home safety, such as the Initial Preventative Physical Exam, Annual Wellness Visit, and Medicare Part B home health care safety assessment. Additionally, the Medicare Part D program includes a Medication Therapy Management (MTM) program for certain enrollees; this requires a comprehensive medication review by a pharmacist or physician. The importance of programs to reduce the risk of falls and fire among older adults is reflected by years of life lost and medical cost calculations. In the US, approximately 222,587 years of life are lost annually due to fires and accidental falls among adults aged 65 or older. Medical costs associated with fire injuries totaled over $213 million in 2019 and medical costs associated with fall injuries were about $50 billion in 2017. Moreover, medical costs associated with deaths from falls and fires were over $960 million in 2019 (expressed in 2017 dollars).
Of the fall prevention programs reviewed, older adults are advised to consult with their medical provider regarding medication use; specific information on medication uses or medication types and its association with fall risk is not addressed. Of the fire prevention programs reviewed, no guidance is provided regarding medication use and fire risk. Ensuring continued risk reduction program success requires continued evaluation of target populations and identification of on-going and new risks. The findings of this research show an association between medication use and fall and fire risk in older adults, and further indicates a need for risk reduction programs targeted at minimizing these risks.
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1. INTRODUCTION

According to NFPA, individuals who are aged 65 or older have a higher incidence of fall and fire-related injuries and deaths when compared to the general population\(^1\). Between 2014-2018, Ahrens et al. found that approximately one-third of fire injuries and deaths involved older adults (Ahrens, 2020). Falls account for 1 in 17 visits to the hospital for the older population (Vastis, 2020). Moreover, fire departments received more fall-related medical service calls than those for structure fires; a 35% increase in medical service calls occurred between 2014 and 2017 (Vastis, 2020).

NFPA, in conjunction with the Centers for Disease Control and Prevention (CDC), created the Remembering When program to address the disparity in incidences, injuries and deaths due to fires and falls amongst older adults. The program is designed to bring together the fire service and public health organizations. The program aids organizations in developing community risk reduction programs targeted at reducing fall and fire susceptibilities in the older population. The program’s framework includes eight fall prevention messages and eight fire prevention messages. The fall prevention messages aim to educate the older population on the importance of exercise, proper shoe wear, safe walking surfaces, and other mindful movement practices. The fire prevention messages aim to educate the older population on the hazards and safe use of smoking materials, space heaters, and cooking appliances. The fire prevention messages also educate the older population on how to react if their clothing catches fire, the importance of smoke alarms and escape plans, and how to contact emergency personnel.

Numerous evaluations have been conducted to measure the success of the Remembering When program (Leitner, 1998; Ottoson, 2004; Casteel, 2016). In general, these studies found that the program has positively impacted older adults and provided them with an increased knowledge of fall and fire risks and prevention strategies. Ensuring continued prosperity of a program, however, requires continued evaluation of the program’s success measures. More so, it requires adaptation of the program to ensure it continues to meet the needs of the population it aims to serve. Further, when the program is safety related, it requires continual identification of causal factors linked to increased risks, which can change over time.

Further refinement of the Remembering When program and development of additional community risk reduction aids and tools requires further exploration into causal factors. One hypothesis suggests that the increased risk of falls and fires in the older population is associated with their use of medication(s). This hypothesis assumes that certain medications negatively impact behaviors, cognitive function, and/or motor skills leading to a higher likelihood of injuries and deaths from falls and fires. The Remembering When program’s current fire and fall prevention messages do not address medication as a causal factor. The objective of this research was to test this hypothesis by conducting a literature review and assessing the healthcare landscape in Phase 1. In Phase 2, research efforts were focused on case studies and current community risk reduction programs to determine their impact on fire and fall risks in the older population.

2. SCOPE

Phase 1 of the research project included two tasks. The first task was to conduct a literature review on medication use and its relationship to fall and fire risks in age groups 50-64 and 65 and older. The second task was to characterize the healthcare payer landscape related to older adults (65 and older), medications, and falls by reviewing and analyzing available data. Phase 2 of the research project included two tasks. The first task was to investigate case studies related to medications and risk factors for falls/fires. The second task was to review and present a summary of fall and fire prevention/intervention
programs currently being used in the field. This report includes a comprehensive summary of findings from both phases of the project.

3. LITERATURE REVIEW

A literature review was conducted to identify and summarize the findings in the literature on medication use and its role in older population fall and fire risks. This task focused on the following points: a) demographic factors associated with falls and fires, b) medication uses in older adults, c) the impact of medications on falls and fires, d) common medications linked to falls and fires, and e) available data on medications linked to falls and fires. Appendix A provides a summary of findings from the literature review.

3.1 Demographic Factors-Falls

Google Scholar was utilized to search for literature that included the terms "demographic", "falls", "older adults", "elderly", "United States". The goal was to identify literature published within the last five years such that analyzed data sets would represent trends within the last decade. Due to the limited number of relevant articles found in the five-year search, the search was expanded to include publications from 2011 to present. Demographic factors included age (i.e., 50-64 years old and 65 years and older), gender, race, ethnicity, and geographic location. Articles were sorted by relevance.

The literature review focused on articles that provided demographic data for the older population rather than a specific cohort within that population. For example, publications which limited demographic data to a specific condition related to a higher risk of falling, such as multiple sclerosis or hearing impairment, were excluded from the literature review. Reviews focused on literature which provided demographic data for the entire country as opposed to data from a single location in the U.S.

Older publications assessing older datasets were excluded when more recent publications evaluating the same but newer datasets were available. For example, Bergen, Stevens, and Burns (2016) analyzed trends in non-fatal falls and fall-related injuries using data from the 2014 BRFSS. Moreland, Kahara, and Henry repeated the same analyses using data from the 2012 through 2018 BRFSS. Since the article by Moreland et al. (2020) analyzed the most recent data available from BRFSS, only this article was included in the literature review.

3.1.1 Moreland, Kakara, and Henry, 2020 (Data Source: BRFSS, 2012-2018)

Moreland, Kakara, and Henry (2020) published a study for the Centers for Disease Control and Prevention (CDC) in which they analyzed trends in non-fatal falls and fall related injuries. The researchers used data from the BRFSS for years 2012, 2014, 2016, and 2018. BRFSS collects data on falls and fall related injuries every two years. The BRFSS program includes a survey of adults, aged 45 years and older, to determine (1) the number of times they have fallen in the past 12 months, and (2) whether the fall caused an injury. Institutionalized adults are excluded from the survey. The researchers noted that the survey was subject to recall bias and that BRFSS only had a 49.9% response rate.

In 2018, 27.5% of respondents, aged 65 years or older, reported a minimum of one fall with 10.2% reporting a minimum of one fall-related injury. Adults aged 85 years or older had a higher rate of falls and fall-related injuries (816 and 227, respectively) when compared to adults, aged 65-74 (700 and 160,
respectively) and aged 75-84 (707 and 170, respectively). For ages 65 years and older, males had a higher rate of falls (735), but a lower rate of fall-related injuries (140) when compared to females (695 and 193, respectively). For ages 65 years and older and excluding the “Multiple/Other” Race/Ethnicity category, Native American/Alaskan Natives reported the highest fall rates (1169), followed by Caucasians (738) and Hispanics (677), African Americans (526), and Asian American/Pacific Islanders (250). For ages 65 years and older, Native American/Alaskan Natives (360) reported the highest fall-related injury rates, followed by Hispanics (192), Caucasians (170), African Americans (122), and Asian American/Pacific Islanders (90). Elderly adults living in rural areas reported a higher rate of falls and fall-related injuries (858 and 180, respectively) when compared to those living in an urban area (682 and 167, respectively).

Respondents were asked to rate and report aspects of their health. Moreland et al. found an inverse relationship between health and falls and fall-related injuries. As self-reported health decreased, fall and fall-related injury rates increased. Those that reported difficulty seeing, concentrating, climbing stairs, performing errands without aid, and dressing and bathing without aid had a higher rate of falls and fall-related injuries compared to those that had no difficulty with these same tasks. Adult aged, 65 years and older, who performed physical activity in the past month of being surveyed had a lower rate of falls and fall-related injuries (583 and 131, respectively) compared to those who did not perform physical activity in the last month (989 and 253, respectively). It is unknown, however, if the reported fall caused the physical impairment leading to reduced physical activity, or vice versa.

3.1.2 Burns and Kakara, 2018 (Data Source: CDC WONDER, 2007-2016)

Burns and Kakara (2018) analyzed trends in fall mortality in adults aged 65 years and older in the United States using data from 2007 to 2016. The data was obtained from the CDC WONDER database and sorted by age group, sex, race/ethnicity, and geography. Rates were age-adjusted based upon the 2000 U.S. standard population. Age adjustment, however, was determined using data from the U.S. Census, which researchers noted could lead to an overestimation in fall mortalities. Researchers also noted that changes in the coding of deaths during the reporting period and misclassifications of deaths was a limitation.

From 2007 to 2016, the rate of deaths from falls increased by 31% or an average rate of 3.0% per year. In 2016, fall fatality rates (i.e., deaths per 100,000) were highest in males (72.3), Caucasians (68.7), and adults, aged 85 years and older (257.9); however, females had a higher rate of non-fatal falls. Rates amongst all age groups, races/ethnicities, and population concentrations increased from 2007 to 2016, except for Native Americans. Researchers noted that death rates in Hispanics, Asian Americans/Pacific Islanders, and Native Americans could be underestimated, because those responsible for reporting deaths (e.g., funeral directors) may report race/ethnicity by observation only which could result in inaccurate categorization.

Alabama had the lowest fall fatality rate at 24.4 per 100,000 population, while Wisconsin had the highest fall fatality rate of 142.7 per 100,000 population; this difference was attributed to the higher concentration of older, Caucasian adults in Wisconsin. All states except for Hawaii, New Mexico, and Vermont, saw increases in death rates between 2007 and 2016. In 2016, the highest rate of deaths occurred in small metro areas, which was defined as a metropolitan statistical area of less than 250,000 persons.
3.1.3 Shankar, Liu, and Ganz, 2017 (Data Source: NHMAC, 2003 to 2010)

Shankar, Liu, and Ganz (2017) analyzed trends in fall-related emergency department (ED) visits among U.S. adults, aged 65 years and older. The study utilized data from 2003 to 2010 obtained from the National Hospital Ambulatory Medical Care Survey (NHMACS). Data was collected and stratified by age, sex, race/ethnicity, and region. Researchers noted that the data collected from 2005 to 2006 had wide confidence intervals due to a small sample size; those numbers were reported for completeness, not accuracy. They also note that NHMACS does not account for repeated falls.

Between 2003 and 2010, researchers reported a 27% increase in fall or fall-related injury visits to the ED for adults 65 years and older. However, researchers indicated that the increases in ED visits for falls could be attributed to overall increases in hospital visits in the elderly population. From 2006 to 2010, the American Hospital Association reported an increase in illness severity among patients receiving ED care and greater use of the ED by those who were eligible for Medicare and Medicaid. Between 2003 and 2010, the most significant ED visit annualized rate difference occurred in adults aged 75-84 years (4.5), Caucasians (3.4), females (3.5), and patients from the southern portions of the U.S. (5.3).

It was noted that life expectancy in the U.S. has increased since 2000, particularly for Caucasian men. Researchers attributed the higher fall injury rates to the increased frailty and disability that is associated with advancing age. While the ED visit rates for males remained relatively constant (50.5 per 1000 to 52.2 per 1000), the number of ED visits for females increased over the seven-year period (67.4 per 1000 to 81.3 per 1000). Researchers attributed the increase to the tendency of females to live longer than males and their reluctance to participate in riskier activities compared to males. Additionally, it was suggested that males visiting the ED may not have been coded as having a fall injury. The study did not offer any explanation for the higher fall rate in the Caucasian population when compared to other races/ethnicities. Researchers offered lifestyle, poor nutrition, or poverty as causal factors for the higher fall risk in the South.

3.1.4 Verma et al., 2015 (Data Source: NHIS, 2004-2013)

In 2015, Verma et al. published an article on trends in U.S. fall rates and fall-related injuries in community dwelling adults, 18 to 65+ years old. For fall rate data, researchers used the 2008 National Health Interview Survey (NHIS) supplement. For fall-related injury data, researchers used the NHIS annual surveys from 2004 to 2013. The data was stratified by fallers and non-fallers, gender, age group, and injury type (for the 2004 to 2013 data). The 2008 NHIS supplement defined fallers as adults that had fallen at least once in the past twelve months. The 2004 to 2013 NHIS annual surveys defined fallers as having fallen at least once in the previous three months; the NHIS data accounts for repeated fallers.

From 2004 to 2013, an estimated 3.2 million adults aged 65 years or older, reported at least one fall-related injury. Adults aged 75 and older had higher fall rates and fall-related injury rates per 100 persons when compared to adults 65-74 years old (50.56 versus 42.62 and 12.8 versus 7.85, respectively). In the age group 65-74 years old, females had higher fall and fall-injury rates than males (42.62 versus 41.32 and 7.85 versus 4.29, respectively). In the age group 75+, males had a higher fall rate and lower injury rate when compared to females (61.97 versus 50.56 and 8.55 and 12.8, respectively). Contusions with intact skin surface were the most common fall-related injury in both males and females, 65 years and older. Older adults were also more likely to experience severe injury due to falls compared to young and middle-aged adults.
3.1.5 Alamgir, Muazzam, and Nasrullah, 2011 (Data Source: WISQARS, 2003-2007)

Alamgir, Muazzam, and Nasrullah (2011) analyzed the demographics of adults, aged 65 years and older, suffering from falls and fall-related injuries in the United States between 2003 and 2007. The data was taken from the CDC’s Web-based Injury Statistics Query and Reporting System (WISQARS), which provides mortality reports based on U.S. death certificates. The mortality reports were filtered by “unintentional falls in adults aged 65 years and older.” Adults were then categorized by sex, race/ethnicity, and state.

From 2003 to 2007, fall fatality rates increased from 36.76 per 100,000 population to 44.89 per 100,000 population. Out of all unintentional injury mortalities, 43.8% were caused by falls. Adults 85 years and older (149.94), males (50.95), and Caucasians (43.03) had the highest fall fatality rates when compared to other age, gender, and ethnicity groups, respectively. Fall rate roughly doubled with each successive age group (65-74 years at 9.05, 75-79 years at 16.35, 80-84 years at 31.76, 85+ years at 63.92, and 85+ years at 149.94). While females reported a higher number of falls (42,965 versus 36,421) and had a higher percentage of falls in unintentional injury fatalities (46.90% versus 40.71%), males had a higher fall fatality rate (50.95 versus 34.41); this finding is consistent with Burns and Kakara (2018) who also found that males had a higher fall fatality rate. Females had the highest percent change in fall mortality rate between 2003 and 2007 (22.54%), as did Caucasians (23.54%). Asian Americans/Pacific Islanders had a negative percent change in fall fatality rate between 2003 and 2007 (-0.62%).

California, Florida, and Texas encompassed 22% of all fall fatalities. Between 2003 and 2007, the highest fall fatality rate was found in New Mexico at 97.63 per 100,000, while Alabama had the lowest fall fatality rate at 20.19 per 100,000. Vermont had the second highest fall fatality rate (95.21) followed by Wisconsin (90.28). Overall, researchers concluded that fall fatality rates were on the rise in the U.S., with falls being the leading cause of home injury deaths. Additionally, for every fall mortality, the CDC estimated that there were another 136 fall injury incidents requiring hospital emergency treatment.

3.2 Demographic Factors-Fires

The most recent demographic data published by the National Fire Protection Association and United States Fire Administration (USFA) is presented below. The data focuses on individuals aged 50-64 and 65+, additional demographic factors included gender, race, ethnicity, and geographic location. These sources provide a comprehensive reporting of information pertaining to the entire U.S. populations based upon data from the National Fire Incident Reporting System (NFIRS) and other sources.

3.2.1 United States Fire Administration, 2019 (Data Sources: NFIRS, NCHS, U.S. Census, 2009-2018)

The USFA publishes data on fire deaths by gender, age, race, and State. The data comes from sources such as the National Fire Incident Reporting System, National Center for Health Statistics (NCHS), and U.S. Census Bureau. California, Texas, and New York had the highest number of fire deaths; however, Mississippi, Oklahoma, Tennessee, and Kansas had the highest number of deaths per million population. In 2018, irrespective of age, males (58.7%) were more likely to die or get injured in a fire than females (41.3%). Putting aside age, African American and American Indian males were found to have the highest occurrences of death per million population at 21.6 and 17.2, respectively. Considering age, adults 50-54 years old had the highest occurrence of injury per million population (63.8), whereas adults aged 85 years and older had the highest occurrence of death per million population (44.8). The relative risk of dying in
a fire was approximately 2.6 for adults aged 65+ from 2009 to 2018. According to USFA (2018), "The older adult population faces the greatest relative risk of dying in a fire."

3.2.2 Ahrens, 2019 (Data Sources: NCHS, CDC WONDER, ACS, U.S. Census, BRFSS, 2013-2017)

In 2019, Ahrens published NFPA’s annual report on fire death rates in the U.S. Death certificate data was obtained from the National Center for Health Statistics and used to calculate the total fire/flame deaths from 2013 to 2017. Demographic information was obtained from sources such as the American Community Survey, U.S. Census Bureau, and BRFSS. Considering only race or ethnicity (and not age), Ahrens found that Native Americans/Alaska Natives had the highest deaths per million population (19) followed by African Americans/Blacks (15), White (Non-Hispanic) individuals (11), Hispanics/Latinos (4), and Asians/Pacific Islanders (3). In individuals 45 to 54 years old, the Native American/Alaska Native population had the highest deaths per million population (27). Whereas, in the 55 and older category (i.e., 55-64, 65-74, 75-84, and 85+), deaths per million population were highest in African Americans/Blacks followed by Native American/Alaska Natives and much higher when compared to the White population. Ahrens also found that death rates increased with increasing age in the 55+ population with significantly high death rates for African Americans/Blacks and Native American/Alaska Natives, age 75 and older.

Geographically, the southern part of the U.S. had the highest predominance of fire deaths between 2013 and 2017; out of the 10 states with the highest fire death rates in the U.S., 9 were in the South. Ahrens noted a correlation between fire death rates and disability, low income, smoking, rural areas, and ethnicity (i.e., African American/Black and Native American/Alaskan Native).


Ahrens (2018) evaluated the relationship between age and gender and home fire deaths and injuries occurring between 2011 and 2015. Occupancies included one- and two-family dwellings, manufactured homes, apartments, and multi-family housing. Ahrens found that males were more likely to die or become injured in a fire accounting for 57% of fire deaths and 54% of fire injuries. The largest number of deaths (480 persons) occurred in individuals 55 to 64 years old. Two age groups, 45-54 and 65-74 years old, tied for the second most populous category, each with 380 deaths.

Focusing on the 50 to 64 and 65 and older categories, those aged 45-54 were the second largest number of individuals injured in fires (2020 persons). Individuals aged 55-64 were the fourth most populous group injured in fires (1690 persons), and those aged 65-74 were the sixth most populous group injured in fires (980 persons). Individuals aged 45 and older accounted for 45% of fire-related injuries and 67% of fire-related deaths.

3.2.4 American Burn Association, 2016 (Data Source: NBR, 2005-2014)

The American Burn Association (ABA), National Burn Repository (NBR) contains data on burn related injuries in the U.S. The Burn Incident Fact Sheet provides a summary of demographic factors associated with victims burned between 2005-2014 (ABA, 2016). Of those injured, 68% were male and 32% were female. With regards to ethnicity, 59% were Caucasian, 20% were African American, 14% were Hispanic, and 7% were categorized as "Other". Demographic factors were not sorted by age. The data included burns sustained from fire/flame, scald, contact, electrical, chemical, and other in locations described as homes, occupational, street/highway, recreational/sport, and other.
3.3 Medication Use in Older Adults

Google Scholar was utilized to search for literature that included the terms "medication use", "cannabis use", "alcohol use", "older adults", "elderly", and "United States". The goal was to identify literature published within the last five years such that analyzed data sets would represent trends within the last decade. Due to the limited number of relevant articles found in the five-year search, the search was expanded to include publications from 2011 to present. Articles were sorted by relevance. Articles pertaining to medication use in nursing homes or other institutionalized settings were not included in the review. The focus of the review was on research related to community-dwelling older adults. A publication that evaluated an older dataset from the same source was excluded from review where a newer publication and newer dataset analysis was available.

3.3.1 Han and Palamar, 2020 (Data Source: NSDUH, 2015-2018)

Han and Palamar (2020) analyzed the prevalence of cannabis use in adults 65 years and older using data from the National Survey on Drug Use and Health (NSDUH). The researchers looked at four cohorts from 2015 to 2018. Cannabis was defined as smoked or ingested marijuana, hashish, pot, grass, and hash oil. They found that past-year cannabis use increased from 2.4% in 2015 to 4.2% in 2018. Between 2015 and 2018, increased use was found in males and females with males having a greater increase when compared to females (i.e., 2.1% to 1.4%). Increased use was also seen in all races with non-Hispanic whites having a less significant increase when compared to all other races and ethnicities (1.2% versus 3.7%). In the time span studied, there was an overall increase in cannabis use in older adults with chronic diseases such as diabetes, heart disease, hypertension, and cancer. Adults with less than two chronic diseases saw a greater increase in use than those with two or more chronic diseases. The percentage of cannabis users being treated for mental health illness increased from 2.8% in 2015 to 7.2% in 2018. There was also an increase in adults that used alcohol and tobacco in the past year in combination with cannabis (e.g., 4.3% change in tobacco use and 3.4% change in alcohol use).

3.3.2 CDC, National Health and Nutrition Examination Survey, 2019 (Data Source: NHANES, 2015-2018)

The CDC, National Center for Health Statistics, National Health and Nutrition Examination Survey (NHANES) tracks prescription medication use in the U.S. population. The most recent report included data from 1988 to 1994 through 2015 to 2018. The survey utilizes three categories for medication use: at least one prescription drug in the past 30 days, three or more prescription drugs in the past 30 days, or five or more prescription drugs in the past 30 days. Between 2015 to 2018, a reported 67.1%, 36.5%, 18.0% of adults, aged 45 to 64 indicated at least one, three or more, and five or more prescription drugs used in the last 30 days, respectively. Between 2015-2018, a reported 85.5%, 66.4%, 41.9% of adults, aged 65 and older indicated at least one, three or more, and five or more prescription drugs used in the last 30 days, respectively.

3.3.3 Han, Moore, Ferris, and Palamar, 2019 (Data Source: NSDUH, 2015-2017)

Han, Moore, Ferris, and Palamar (2019) studied data related to binge drinking in adults, 65 years and older. Data from 2015 to 2017 was obtained from NSDUH. Binge alcohol use was defined as "five or more drinks on the same occasion for men and four or more drinks on the same occasion for women". Binge drinking was identified in over a tenth (10.6%) of the 10,927 participants. A higher percentage of binge
drinkers were male (58.3% versus 41.7%). In past-month binge drinking in past-month alcohol users, Non-Hispanic African Americans had the highest prevalence when compared to non-Hispanic whites (1.44) followed by Non-Hispanic Asians (1.31), Hispanics (1.31), and Other Races/Ethnicities (1.19). A higher prevalence of binge drinking was also seen in tobacco users (1.52), cannabis users (1.41), and prescription psychotherapeutic drug misusers (1.12). Those that received mental health treatment or had a severe mental illness also had a higher prevalence of binge drinking (1.23 and 1.10, respectively).

3.3.4 Nothelle, Sharma, Oakes, Jackson, and Segal, 2019 (Data Source: Literature Review, 2006-2017)

Nothelle, Sharma, Oakes, Jackson, and Segal (2019) reviewed the literature to identify factors which influence potentially inappropriate medication (PIM) use in older adults. Older adults were defined as aged 65 years and older. From the twenty-two studies reviewed, Nothelle et al. found that being female, taking multiple medications, or having increased healthcare facility visits (e.g., frequent visits to outpatient and emergency departments) were associated with PIM use. In studies that evaluated geographic locations in the U.S., the southern and western portions of the U.S. had a higher association with PIM use. The criteria used to define PIM varied between studies reviewed, however, most of the studies utilized Beers Criteria from varying years.

3.3.5 CDC, National Health Interview Survey, 2018 (Data Source: NHIS, 2018)

The CDC, National Health Interview Survey (NHIS) is a face-to-face survey conducted continuously by the CDC throughout the United States. Participants are selected using geographically clustered sampling techniques, including those living in households and noninstitutional group quarters. The data collected is made available by year. The most recent data on alcohol use in the U.S. was released in 2018. The survey utilizes five categories for alcohol use: lifetime abstainer, former infrequent, former regular, current infrequent, and current regular. Current infrequent users were defined as those individuals that had "at least 12 drinks in his or her lifetime and fewer than 12 drinks in the past year." Current regular users were defined as those individuals that had "at least 12 drinks in his or her lifetime and at least 12 drinks in the past year."

The highest age-adjusted percent distribution for all selected characteristics (gender, age, race, education, current employment status, family income, poverty status, health insurance coverage, marital status, place of residence, region) was consistently in the “current regular” category with only a few exceptions. For adults aged 45 to 64 years old, 14.5% were current infrequent users and 53.5% were current regular users. Using age-adjusted percent distribution, 13.9% of adults aged 65-74 were current infrequent users and 45.0% were current regular users. For adults aged 75 and over, 12.2% were current infrequent users and 33% were current regular users. Current regular use was highest in Asians (14.7%) in participants identifying with only one race category and African Americans/Caucasians (19.9%) in participants identifying with two or more race categories.

3.3.6 Hanlon et al., 2017 (Data Source: Health ABC Survey, 1997-2013)

Hanlon et al. (2017) investigated the potential drug-drug and drug-disease (i.e., condition) interactions in well-functioning, community dwelling older adults. The sample population consisted of 3,055 adults aged 70-79 years of the African American and Caucasian races. The participants were enrolled in the baseline survey of the Health, Aging, and Body Composition. The survey was limited to participants in Pittsburgh,
PA and Memphis, TN. "Well-functioning" was defined as having no difficulty walking a quarter of a mile or up a flight of stairs. The potential drug-drug interactions were identified using the 2015 update of the American Geriatrics Society (AGS), Beers Criteria. Interactions were also categorized by their mechanism, either pharmacokinetic or pharmacodynamic.

Over 34.0% of participants had at least one drug interaction, 25.1% had one or more drug-drug interactions, and approximately 10.7% had a drug-drug interaction involving an over-the-counter (OTC) medication. Nonsteroidal, anti-inflammatory drugs (NSAIDs) were the most common drug class affecting other drugs, whereas cardiovascular agents were the most affected drug class. Negative interactions between hypertensives and NSAID was the most common drug-drug interaction. Antithrombotics were the second most common affected class, followed by endocrine agents, and central nervous system (CNS) agents.

Researchers identified drug-disease interactions in 16% of the population studied and 3.7% of the population had one OTC linked to an interaction. Individuals with a history of falls or fractures were the second most likely group to experience drug-disease (condition) interactions (121 participants or 4% of study population). Benzodiazepines were the most common drug class affecting those with a history of falls or fractures, followed by selective serotonin reuptake inhibitors (SSRIs), anticonvulsants, tricyclic antidepressants (TCAs), and antipsychotics.

3.3.7 Holton, Gallagher, Fahey, and Cousins, 2017 (Data Source: Literature Review, 1990-2016)

In 2017, Holton, Gallagher, Fahey, and Cousins published their findings from a literature review on the prevalence of concurrent use of alcohol and alcohol interactive (AI) medications in older adults. The researchers utilized MEDLINE and searched for relevant publications from 1990 to 2016. The studies relied on self-reported alcohol consumption; however, some studies were considered to have less risk of bias, because they reported on the quantity and frequency of alcohol consumption within a specific period. Seven of the twenty studies included were conducted in the United States. Based on the literature reviewed, the researchers concluded that concurrent use of alcohol and AI medications in older adults ranged from 21 to 35%. Concurrent use of alcohol and psychotropic drugs in older adults ranged from 7.4 to 7.75%. Researchers did note that there was inconsistency in defining AI medications across various studies.

3.3.8 Qato, Wilder, Schumm, Gilet, and Alexander, 2016 (Data Source: NSHAP, 2005-2011)

Qato, Wilder, Schumm, Gilet, and Alexander (2016) evaluated prescription medication use and polypharmacy in U.S. adults, aged 62 to 85. Polypharmacy was defined as the concurrent use of five or more prescription medications. The researchers compared medication use data from 2010 to 2011 to that previously obtained in 2005 to 2006. Previous research found that more than 50% of older adults utilized prescription and nonprescription medications (e.g., OTC and dietary supplements) at the same time. The previous study (i.e., 2005 to 2006) was based upon data from the National Social Life, Health, and Aging Project (NSHAP). The NSHAP included in-home interviews where participants were asked to identify all medications they used on a regular basis, both prescription and non-prescription.

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1 AGS describes the Beers Criteria as "...a compendium of medications potentially to avoid or consider with caution because they often present an unfavorable balance of benefits and harms for older people..." (AGS, 2019)
Follow-up interviews were conducted with the study participants between 2010 and 2011. They were asked the same questions posed to them in the 2005 to 2006 study regarding their medication use. Using the old and new data, researchers characterized and quantified the frequency and type of drug-drug interactions in older adults. A total of 4,400 participants were selected with 1555 individuals having participated in both the 2005/2006 and 2010/2011 surveys.

Researchers found that the use of prescription medications increased slightly from 84.1% in 2005/2006 to 87.7% in 2010/2011. Polypharmacy increased from 30.6% in 2005/2006 to 35.8% in 2010/2011. There was a decrease in the percentage of older adults using OTCs (44.4% to 37.9%), however, dietary supplement use increased (51.8% to 63.7%). Statins (33.8% to 46.2%), antiplatelet medications (32.8% to 43.0%), and omega-3 fish oils (4.7% to 18.6%) had the most significant increases in use between 2005-2006 and 2010-2011.

Researchers concluded that in 2010 to 2011, 15.1% of older adults were "at risk for a potential major drug-drug interaction" compared to only 8.4% in 2005 to 2006. Antihypertensives were the most used drug class and were often used in interacting drug regimens. OTC analgesics, such as aspirin and naproxen, were the second most common drug class. Overall, the study concluded that 1 in 6 older adults were at risk for a negative polypharmacy outcome.

3.3.9 Charlesworth, Smit, Lee, Alramadhan, and Odden, 2015 (Data Source: NHANES, 1988-2010)

Charlesworth et al. (2015) evaluated trends in prescription medication use and polypharmacy in adults aged 65 and older using data from NHANES. Twenty years of data on medication use, ranging from 1988 to 2010, was evaluated in the study. Researchers found that prescription medication use in older adults increased by a factor of two between 1988 and 2010. Individuals taking 5 or more medications increased by a factor of three from 12.8% in 1988 to 39.0% in 2010; increases were attributed to higher use of cardiovascular and antidepressant medications.

Researchers found a decrease in inappropriate medication use from 28.2% in 1998 to 15.1% in 2010. Inappropriate medication use was as defined by the 2003 Beers Criteria. The odds of using one to five or more medications increased with age, number of chronic conditions, and number of health care visits per year. The odds of using five or more medications increased with body mass index, former smoking history, income-poverty ratio, and race other than non-Hispanic blacks.

3.3.10 Kuerbis, Sacco, and Blazer, 2014 (Data Source: Various)

Kuerbis, Sacco, and Blazer (2014) investigated the prevalence of substance abuse disorder (SUD) in older adults, as well as unique vulnerabilities, risk factors, and methods for diagnosis and intervention in older adults. The researchers cited various literature and data sources to support their conclusion that older adults are at risk for SUD.

The study indicated that alcohol was the most used substance in the older adult population. At-risk drinking, which was defined as "more than 3 drinks on one occasion or more than 7 drinks per week", was identified in 16% of males and 10.9% of females. A higher rate of binge drinking was also found in older adults. Additionally, approximately 14% of the elderly population reported using tobacco in the last year, and 6% reported using tobacco in combination with alcohol in the last year.
According to Kuerbis, Sacco, and Blazer, the 2012 National Survey on Drug Use and Health indicated a significant increase in illicit drug use in older adults between 2002 and 2012. The highest prevalence of illicit drug use was found in those 60-64 years old when compared to those 65 and older. Cannabis was a common illicit drug used by older adults with 4.6 million reporting use of the drug in 2012 compared to less than 1 million reporting use of "...cocaine, inhalants, hallucinogens, methamphetamines, and/or heroin..."

Researchers found that adults aged 57-85 took more prescription medications and OTCs than younger individuals. One cited study found that 37.1% of male older adults and 36.0% of female older adults took 5 or more prescription drugs. Additionally, benzodiazepines were indicated to be the most prescribed, psychoactive medication among older adults.

3.4 Medication Use, Common Medications, and Available Data- Falls

Google Scholar was utilized to search for literature that included the terms "falls", "medication use", "older adults", "elderly". The goal was to identify literature published within the last five years such that analyzed data sets would represent trends within the last decade. A considerable amount of newer research has been published on this topic. As such, only a few seminal articles more than five years old have also been included in the review.

Articles were sorted by relevance. Articles pertaining to medication use in the nursing homes or other institutionalized settings were not included in the review. The focus of the review was on research related to community-dwelling older adults. Moreover, the purpose of this literature review was to uncover data on medication classes which impact fall potential. This topic is not geographically dependent, unlike data on demographics or trends in general medication use. As such, this portion of the literature review was expanded to include datasets from outside of the U.S.

3.4.1 Lohman, Fairchild, and Merchant, 2021 (Data Source: HRS and PDS, 2004-2006)

Lohman, Fairchild, and Merchant (2021) investigated the relationship between antidepressant use and falls and fall-related injuries. The study utilized the 2004 to 2006 data from the Health and Retirement Study (HRS) and 2005 data from the Prescription Drug Study (PDS). The population studied were community-dwelling adults, aged 65 and older. The study found a statistically significant relationship between major depressive disorder and falls and fall-related injuries. Odd Ratios for falls and fall-related injuries were 1.92 and 1.67, respectively. Antidepressant medication use accounted for 19% of the association between major depressive disorder and falls and 18% of the association between major depressive disorder and fall-related injuries.

3.4.2 Haddad, Luo, Bergen, Legha, and Atherly, 2021 (Date Source: MCBS, 2009-2013)

Haddad, Luo, Bergen, Legha, and Atherly (2021) studied the relationship between psychoactive medications use, mainly antidepressants, and falls in community dwelling adults, 65 years and older. Data was obtained from the 2009 to 2013 Medicare Current Beneficiary Survey (MCBS). Participants were interviewed over a four-year period, three times each year. Falls and medication use were self-reported. Researchers classified psychoactive medications as "opioids, benzodiazepines, sedative-hypnotics (non-benzodiazepines limited to zaleplon, zolpidem, and eszopiclone), antipsychotics, anticonvulsants, and antidepressants." Antidepressants were further separated in subclasses "tricyclic antidepressants (TCA),
selective serotonin reuptake inhibitors (SSRI), serotonin norepinephrine reuptake inhibitors (SNRI), serotonin modulators (SM) (defined as vortioxetine, trazodone, nefazodone, and vilazodone), monoamine oxidase inhibitors (MAOI), and atypical antidepressants (defined as mirtazapine, atomoxetine, and bupropion)."

Using the weighted percent to the US Medicare population of characteristics, opioids were the most commonly reported drug class being used at 31.1% followed by SSRIs (antidepressant subclass) at 13.1% and benzodiazepines at 10.6%. SNRI were the second most used antidepressant subclass at 3.2%. Individuals taking SNRIs were the highest percentage of individuals reporting a fall at 42%. Using the adjusted risk ratio, researchers found that individuals on any antidepressant or psychoactive medication had an increased risk of falling. When considering confounders such as depression and polypharmacy, however, an increased risk was only seen for SSRIs and SNRIs. Haddad et al. (2021) concluded that those taking SSRIs or SNRIs, the risk of falling increased by 30%.

3.4.3 Yoshikawa et al., 2020 (Data Source: Literature Review, inception to 2019)

Yoshikawa et al. (2020) performed a literature review and meta-analysis to assess the relationship between opioid use and falls, fall-related injuries, and fractures in adults, 65 years and older. The literature review included articles published from the inception of the searched databases (i.e., Medline, Embase, CINAHL, PsycInfo, Global Health, Northern Light Life Sciences Conference Abstracts, Cochrane CENTRAL) through 2019. After analyzing 36 studies, researchers concluded that there was a relationship between opioid use and falls, fall-related injuries, and fractures. Furthermore, a greater association was present between fracture risk and opioid use when compared to risk of falls and fall-related injuries.

3.4.4 Beers Criteria, 2019 (Data Source: Beers Criteria, 2019)

In 2019, the American Geriatrics Society updated the Beers criteria, an explicit list of potentially inappropriate medications (PIMs) for older adults. SNRIs were added to the list of drugs to avoid in individuals with a history of falls and fractures. It identified antipsychotics, benzodiazepines and nonbenzodiazepines (e.g., insomnia drugs or z-drugs), as PIMs that cause an increased risk of cognitive impairment, falls, and fractures in older adults. Additionally, older adults with a history of falls and fractures were encouraged to avoid antiepileptics, antipsychotics, benzodiazepines, nonbenzodiazepines, antidepressants, and opioids. Moreover, individuals taking a combination of three or more drugs classified as antipsychotics, antiepileptics, benzodiazepines, nonbenzodiazepines, and opioids, were noted to have an increased fall risk.

3.4.5 Holton et al., 2019 (Data Source: TILDA, 2009-2015)

Holton et al. (2019) investigated the relationship between drug-alcohol interactions and falls in community-dwelling adults, age 65 years and older. Data from 2009 to 2015 was obtained from the Irish Longitudinal Study on Ageing (TILDA) which involves an initial patient interview, and follow-up every two years with clinical assessments every four years. Fall outcomes included any falls, injurious falls (i.e., falls serious enough to require medical treatment), and number of falls. Holton et al. (2019) developed the POSAMINO criteria, otherwise known as potentially serious alcohol–medication interactions in older adults. Twenty-three of the 38 POSAMINO criteria are related to fall risk.
Of the 1457 older adults evaluated, 64% reported alcohol consumption at their first interview. Based upon the baseline interview data, the occurrence of POSAMINO was 12%. Additionally, 7% of all participants were at risk for one “potentially serious falls-related drug-alcohol interaction”, and 5% were at risk for two or more potentially serious falls-related drug-alcohol interactions. During the two-year and four-year interviews, 24% and 41.8% of participants reported falling since the baseline survey, respectively. At two-years, 10% of falls were reported as injurious and at 4 years, 18% of falls were reported as injurious.

Holton et al. (2019) found that "CNS POSAMINO criteria" was linked to a significant increase in fall risk and injurious fall risk, based on 4-year interview data. CNS POSAMINIO criteria are associated with potentially serious alcohol-central nervous system agent interactions in older adults. Examples include heavy alcohol consumption with benzodiazepines, opioids, antipsychotics, and barbiturates, amongst other drugs which target the CNS. Researchers hypothesized that CNS agents result in increased sedation when combined with alcohol which is reasonable given that alcohol itself is a CNS depressant. Holton et al. (2019) concluded, based on the data collected at the 4-year interview, that concurrent use of alcohol and CNS drugs resulted in an absolute fall risk of 19% and absolute injurious fall risk of 8%.

3.4.6 Laberge and Crizzle, 2019 (Data Source: Literature Review, 1988 to 2018)

Laberge and Crizzle (2019) reviewed the literature to identify studies which evaluated fall risk against psychotropic medication use alone and in combination with alcohol use. The review included published works from 1988 to 2018 and included adults, aged 60 and older. Psychotropic drugs were categorized as "benzodiazepine, anti-psychotics, anti-depressants, anti-epileptic, lithium, memantine" and “anti-hypertensives”. Of the 29 studies reviewed, Laberge and Crizzle (2019) concluded that fall risk was associated with the use of benzodiazepines and antidepressants, especially SSRIs. Researchers found no association between fall risk and alcohol, antiepileptics, antipsychotics, and antihypertensives. They drew no conclusions about lithium or memantine, as no relevant literature was found on these drugs.

3.4.7 Ang et al., 2018 (Data Source: Literature Review, inception to 2017)

Ang et al. (2018) performed a systematic review of the literature to evaluate the relationship between antihypertensive medications and risk of falls, injurious falls, and recurrent falls. The literature review included published works from the inception of the searched databases (i.e., PubMed, EMBASE, and CINAHL) to 2017 and focused on adults, 60 years and older. The researchers investigated six medications, "...α-blockers (AB), angiotensin converting enzyme inhibitors (ACEi), angiotensin receptor blockers (ARB), β-blockers (BB), calcium channel blockers (CCB) and diuretics..." After reviewing the data and findings in 78 articles, the researchers concluded that use of ACEi, BB, and CCB medications was associated with a decreased risk of injurious falls; there was no association between falls and recurrent falls and ACEi, BB, and CCB medication use. The data indicated that AB, ARB, and diuretic use was not linked to any fall outcome. Overall, researchers concluded that antihypertensive medication was not likely to result in a higher risk of falls.

3.4.8 Kahlæe, Latt, and Schneider, 2018 (Data Source: Literature Review, 2007-2017)

Kahlæe, Latt, and Schneider (2018) performed a systematic review of the literature to study the relationship between antihypertensive medications and risk of falls in adults, 60 years and older. The antihypertensive medication subclasses evaluated were primarily angiotensin converting enzyme
inhibitors (ACEi), angiotensin receptor blockers (ARB), α-blockers (αB), β-blockers (BB), calcium channel blockers (CCB), diuretics (D), and renin-angiotensin system (RAS). The review included articles published between 2007 and 2017. Based upon a review of 29 studies, researchers found that fall risk was dependent upon the duration of medication use. The risk of falling increased up to 36 times during the first 24 hours of "medication initiation, change, or dose increase." However, researchers concluded that there was no significant relationship between chronic antihypertensive medication use and fall risk.

3.4.9 Díaz-Gutiérrez et al., 2017 (Data Source: Literature Review, 2007-2017)

Díaz-Gutiérrez et al (2017) performed a systematic review of 12 references which explored the relationship between benzodiazepine use and falls in adults aged, 65 years and older. The literature search included works published between 2007 and 2017. Researchers found a relationship between benzodiazepine use, by itself and in combination with other drugs, and increased fall risk. Díaz-Gutiérrez et al. (2017) suggested that short-acting benzodiazepines were more likely to reduce fall risk by reducing cumulative effects associated with longer-acting benzodiazepines. As such, the researchers suggested that benzodiazepine use in older adults should only be as a short-term therapy.


Musich, Wang, Ruiz, Hawkins, and Wicker (2017) studied the relationship between fall-related drug (FRD) use and risk of falls in adults, age 65 and older. Researchers evaluated fall risk in both new FRD users, continuing FRD users, and users taking multiple FRDs. Musich et al. (2017) utilized data from the 2015 AARP Medicare Supplement for insured with AARP Medicare Part D Rx plans; a 10% random sample was obtained from this source. FRD classes were based upon the Healthcare Effectiveness Data and Information Set (HEDIS) which included "anticonvulsants, nonbenzodiazepine hypnotics, selective serotonin reuptake inhibitors (SSRIs), antiemetics, antipsychotics, benzodiazepines, and tricyclic antidepressants."

Musich et al. (2017) found that 44% of participants were using a minimum of one FRD with 29% being new users and 71% being continuing users. Demographically, the most common groups for both types of users (i.e., new and continuing) were females (63% and 69%, respectively), ages 70-79 years old (47% and 47%, respectively), Caucasians (49% and 49%, respectively), and from the South (40% and 42%, respectively). New users most commonly took "benzodiazepines (46%), anticonvulsants (29%), SSRIs (24%), and non-benzodiazepine hypnotics (12%)." Continuing users most commonly took "benzodiazepines (46%), SSRIs (44%), anticonvulsants (33%), and non-benzodiazepine hypnotics (17%)." Researchers found that previous fall history and polypharmacy (four or more FRD classes) were the strongest indicators for increased fall risk. Moreover, new users taking multiple FRDs had a higher risk of falling when compared to continued users taking one FRD.

3.4.11 Chen, Lee, and Buxton, 2017 (Data Source: HRS, 2006-2014)

Chen, Lee, and Buxton (2017) studied the relationship between insomnia symptoms, sleep medications, and fall risk in community-dwelling adults, aged 65 years and older. They utilized data from HRS for years, 2006-2014. Sleep medications were categorized as nonphysician-recommended and physician-recommended. Study participants were surveyed in 2006, 2008, 2010, and 2012 (baseline) and again in 2008, 2010, 2012, and 2014 (i.e., a two-year follow-up).
In the initial survey, 32% of individuals reported a fall, and in the follow-up survey, 34% of individuals reported a fall. Researchers found that reported falls increased with the number of insomnia symptoms; the percent likelihood of falling was 28% with no symptoms and increased to 40% with 4 symptoms. Chen, Lee, and Buxton (2017) also found a larger portion of participants using sleep medications reported falling when compared to those that had no falls. The difference in the number of participants reporting falls versus no falls while taking non-physician recommended medications was small, i.e., 6.4% no falls compared to 6.9% any fall. Conversely, the difference in the number of participants reporting falls versus no falls while taking prescription medications was more significant, i.e., 10.4% no fall compared to 14.7% any fall. Researchers concluded that the number of insomnia symptoms and use of physician-recommended medications individually increase the future fall risk. Moreover, researchers concluded that taking a prescribed sleep medication increased the risk of falling regardless of the severity of insomnia symptoms.

3.4.12 Watanabe, 2016 (Data Source: NHATS, 2011)

Watanabe (2016) studied the relationship between medication use and falls as well as fall-related concerns in adults, aged 65 years and older. Data was obtained from the 2011 National Health and Aging Trends Study (NHATS). Participants were asked questions about fall history, worry related to falling, and prescription medication use. Watanabe (2016) separated responders by three housing types: "private residence", "group home, board and care or supervised housing", and "assisted living facility or continuing care retirement community." Over 99% of participants were living in a private residence, therefore, the results of the study are largely representative of community-dwelling older adults. Watanabe (2016) found that 10.29% of respondents using medication had fallen in the last month and 22.82% had fallen in the last year compared to 5.42% and 13.15% of non-users, respectively. An increase (approximately double) in worry about falling was also seen in respondents who were taking medication when compared to non-users.

3.4.13 de Jong, Elst, and Hartholt, 2013 (Data Source: Literature Review, unknown-2013)

De Jong, Van der Elst, and Hartholt (2013) performed a literature review on drug related falls in older adults. They found that polypharmacy increased the risk of falls due to the higher likelihood of adverse drug reactions (ADRs). Researchers reported that older adults (over 60 years old) account for two-thirds of ADR-related hospitalizations, but that falls are not officially recognized as an ADR, so the exact number of falls caused by drugs is not known. However, de Jong et al. note that fall risk will not increase due to polypharmacy unless one of the drugs being used is a fall risk increasing drug (FRID).

Researchers identify antidepressants, neuroleptics and antipsychotics, benzodiazepines, sedatives and hypnotics, antihypertensive agents, nonsteroidal anti-inflammatory drugs (NSAIDs), diuretics, β blockers, and narcotics as FRIDs. Of these medication types, antidepressants, neuroleptics and antipsychotics, benzodiazepines, sedatives and hypnotics, antihypertensive agents had the highest odds ratios at 1.68, 1.59, 1.57, 1.47, and 1.24, respectively.

De Jong et al. also referenced studies by Van der Velde et al. (2007) and Campbell et al. (1999) where patients were weaned off their regular medications. Van der Velde et al. (2007) evaluated the reduction in FRID use in 139 patients; 67 patients discontinued use and eight patients reduced use. Participants that continued treatment had an average of 3.6 fall incidents, whereas those that discontinued treatment had
an average of 0.3 fall incidents. Campbell et al. (1999) also attempted to withdraw psychotropics from patients; a 66% reduction in falls was found in patients who were weaned from psychotropic drugs.

3.5 Medication Use, Common Medications, and Available Data- Fires

Google Scholar was utilized to search for literature that included the terms "fire", "medication use", "drugs", "older adults", and "elderly". The search returned limited results. Fire science journals and the authors' own familiarity with the topic specific literature was utilized to yield more results. While several studies have identified older adults and individuals using alcohol and/or drugs as independent, susceptible populations, very little research has focused on the potentially synergistic effects of age and alcohol and/or drug use in fire injury and death risk.

The literature presented below represents those studies which have evaluated the independent risks associated with alcohol and drug use as well as limited studies that have looked at the association of these factors with age. McAllister (2021) is currently evaluating the relationship between age and alcohol, prescription, illicit, and over-the-counter drug use in fire deaths. As this is an on-going study, the findings have not yet been published. Some case studies from this on-going research are presented in Section 5 of the report.

3.5.1 Dinaburg, 2020 (Data Source: Literature Review, unreported date range)

In his review of literature, Dinaburg (2020) detailed several studies which investigated the relationship between alcohol and/or drug use and its impact on awakening to an audible alarm. Many of the studies cited by Dinaburg (2020) are summarized below. Dinaburg (2020) points out that those intoxicated or on drugs are part of a susceptible population that does not “fully benefit” from traditional smoke alarm technology. While not a primary study nor focused solely on older adults, Dinaburg’s work is mentioned here as it includes a collection of references relevant to medication use and fires.

3.5.2 Doyle, Lyons, and Lynn, 2019 (Data Source: NDRDI, 2014-2016)

Doyle, Lyons, and Lynn (2019) evaluated coronial data obtained from the National Drug-Related Deaths Index (NDRDI) for years 2014-2016 to identify trends in fire deaths in Ireland. Of the 106 fatalities included in the study, 65% were male and 52% were 65 years or older. Toxicology reports were available for 91 fatalities and of these, 74 fatalities had findings of alcohol and/or drugs. Of the 46 fatalities that were positive for drugs, two-thirds had more than one drug in their system. The most frequently found drugs were antidepressants (46%), benzodiazepines (35%), non-opioid analgesics (33%), hypnotics (24%), and opioids (13%).

Of the 51% of decedents that tested positive for alcohol, 65% had a blood alcohol concentration (BAC) of 0.160% or more. Additionally, 66% of smokers had alcohol in their system and 67% of these had a BAC of 0.160% or greater. For fatalities involving individuals 60 years and older, 76% had alcohol and/or drugs in their system. Of these, 36% tested positive for alcohol only, 33% tested positive for drugs only, and 31% had both alcohol and drugs in their systems.
3.5.3 Harpur, Boyce, and McConnell, 2014 (Data Source: Coronial Reports, 1999-2009)

Harpur, Boyce, and McConnell (2014) investigated contributing factors in fire deaths involving older adults, 60+ years old, in Northern Ireland. A total of 141 accidental, residential fire deaths were evaluated of which 65 individuals were elderly (i.e., 60 years and older). Researchers found that the elderly represented a larger percentage of fire decedents, and within the elderly population, a larger percentage of the decedents were male. Within the older adult, fire death population, 73.8% were smokers and 63.6% were "problem drinkers". A problem drinker was "classified by their GP as an alcoholic or identified by family members or associates as a habitual abuser of alcohol." 50% of older adults tested positive for alcohol. Of those tested for drugs (11 adults), 45.5% tested positive. Detected drug types included pain relievers and benzodiazepines. Only one decedent tested positive for both alcohol and drugs.

3.5.4 Lykiardopoulos, 2014 (Data Source: Human Subject Testing and Coronial Reports, 1998-2007)

Lykiardopoulos (2014) studied the impact of psychotropic drugs on human behavior in fires. Psychotropic drugs were defined as antidepressants, anxiolytics, antipsychotics, mood stabilizers, stimulants, hypnotics, and illicit drugs. The term hypnotic was used interchangeably with the term sedatives. His research had two focus areas. In the first phase of his study, Lykiardopoulos (2014) evaluated the impact of hypnotic drugs on awakening of adults to audible alarms. In the second phase of his study, Lykiardopoulos (2014) analyzed Australian fire deaths and psychotropic and hypnotic drug users and associated risk factors. The awakening tests involved twelve participants, aged 65-80, who indicated hypnotic or sedative drug use, two to six nights a week.

Lykiardopoulos (2014) excluded adults with serious neurological or psychiatric disorders, as well as those that had hearing difficulty. Ten individuals were taking temazepam and one individual was taking nitrazepam; both drugs are benzodiazepines. Another participant was taking zolpidem, a non-benzodiazepine medication commonly prescribed for insomnia. Lykiardopoulos (2014) classified all three medications as hypnotics. Lykiardopoulos (2014) tested the participants’ responses to two different fire alarms, a 3100 Hz sine wave and a 520 Hz square wave, both with and without hypnotic drugs. The hypnotics raised the participants’ auditory threshold by 9 dBA for both waves. At 75 dBA, the 520 Hz square wave woke the participants taking hypnotics every time, whereas two people failed to awaken with the sine wave. With no drugs, only one participant failed to awake when exposed to the 3100 Hz sine wave at 75 dBA.

In the second part of the study, Lykiardopoulos (2014) analyzed 376 fire deaths occurring in Australia between 1998 and 2007. A total of 164 deaths remained after exclusion of non-accidental deaths, non-residential fires, and individuals under the age of 18 years old. Of the 164 fire deaths, 108 individuals were tested for drugs. In those that tested positive, approximately 1.5 psychotropic drugs were found per fatality. Hypnotic/sedative drugs were found in a large portion of the population (28.70%) followed by antidepressants (10.20%) and illicit drugs (3.70%). Lykiardopoulos (2014) found that middle-aged persons (30-60 years old) taking hypnotics were at higher risk of dying when compared to older adults (over 60 years old). He noted that, unlike older adults, middle aged adults were more likely to use both alcohol and sedative drugs or take multiple drugs at the same time. Lykiardopoulos (2014) concluded psychotropic drugs, specifically sedatives, had a profound impact on both awakening and human behavior in fires.
3.5.5 Bruck, Thomas, and Ball, 2007 (Data Source: Human Subject Testing)

Bruck, Thomas, and Ball (2007) studied the abilities of 32 alcohol impaired individuals, ages 18-26, to awaken to an audible alarm. The researchers evaluated awakening to a 400 Hz square wave, 520 Hz square wave, 500 Hz pure tone, 3100 Hz pure tone, bed shaker, pillow shaker, and strobe light. All signals had a temporal three (T-3) pulse. The target BAC for participants was 0.05% which was considered mild impairment.

Bruck, Thomas, and Ball (2007) found that the 400 Hz and 520 Hz square wave signals were most effective in awakening when compared to the traditional 3100 Hz pure tone signal. Approximately 93-100% of participants with a 0.05% BAC awoke to the low frequency wave signals, compared to 61.5% who awoke to the high frequency, pure tone signal. Bed and pillow shakers and strobe lights were considered ineffective in awakening the mildly intoxicated participants.

3.5.7 Ball and Bruck, 2004 (Data Source: Human Subject Testing)

Ball and Bruck (2004) assessed the awakening effectiveness of three alerting tones on twelve, intoxicated, college-age subjects ranging in age from 18-25 years. The tones included a female voice, rapid, high-pitched beeping smoke alarm (Australian Standard Alarm (ASA)), and T-3 smoke alarm. Participant target BACs were 0.05% and 0.08%. Ball and Bruck (2004) found that a person’s ability to awaken to an audible alarm was significantly reduced when the subject consumed alcohol. Regardless of the type of audible tone, 36% of the subjects with a BAC of 0.05% slept through tones less than 95 decibels (dBA) or did not respond at any sound level. This is compared to the 6% of subjects in the sober condition who slept through tones less than 95 dBA or did not respond at any sound level. The female voice and T-3 alarms awoke all sober participants before reaching 95dBA.

The percentage of subjects who slept through the alarms increased to 41% when BAC increased to 0.08%. The conclusion of the study was that one third of people with a blood alcohol level of 0.05% and half of people with a blood alcohol level of 0.08% will not respond to a smoke alarm at the standard code mandated sound levels (75 dB at the pillow location). Ball and Bruck (2004) concluded that “drinking alcohol, even in moderation, will adversely affect a person’s ability to awaken to their smoke alarm.”

3.5.8 Bruck, 2001 (Date Source: Various, unreported date range)

Bruck (2001) published a literature review for the *Fire Safety Journal* in which she explored factors which affect sleep arousal. Relevant to this paper are factors such as age and alcohol, marijuana, and sleeping medication use. Bruck (2001) concluded that 25% of older adults (60+) are unlikely to awaken to an alarm at 55 dBA, and 10% are unlikely to awaken to an alarm at 75 dBA. Bruck reported the elderly population in Australia were consuming 41% of all prescribed sleep medications and postulated that they were less likely to wake to an alarm for this reason.

As this paper pre-dated Bruck's later work (2004, 2007), she pointed out that there were no studies on the correlation between alcohol and auditory arousal thresholds; however, she noted that alcohol does increase deep sleep in the first two hours of sleep. Similarly, Bruck (2001) pointed out the lack of studies on marijuana and sleep effects but noted that increased drowsiness has been found in long-term users. Overall, she concluded that sleep medications, alcohol, and marijuana were likely to impact arousal threshold.
3.5.9 Marshall, Runyan, Bangdiwala, and Linzer, 1998 (Data Source: Coronial Reports, 1988-1989)

Marshall, Runyan, Bangdiwala, and Linzer (1998) investigated trends in fire deaths in North Carolina between 1988 and 1989. A total of 190 fire deaths were reviewed and 21% of decedents were 64 years or older. BAC was measured in 92% of the decedents, aged 18 years and older. Of those measured, 53% of decedents had a BAC greater than 0.10%. Increased fatality rates were seen in individuals with physical or cognitive disabilities, those impaired by alcohol or drugs, those 64 years and older, and those younger than 5 years old. The study did not detail the specific drugs found. Where multiple persons were present during a fire, smoke alarms were found to be effective in reducing the risk of dying in a fire. Researchers also concluded that smoke alarms reduced the risk of dying in a fire for both normal and susceptible populations.

3.5.10 Grace, 1997 (Data Source: Various, unreported date range)

Grace (1997) explored the characteristics of sleep and how drugs affect waking to fire alarms. He outlined a series of tests performed by Johnson et al. (1978) in which smoke alarm awakening ability was tested in 36 young adults under the influence of Triazolam, a benzodiazepine. A total of 50% of the drugged subjects did not awaken to the first alarm signal, while all the placebo subjects did awaken. In his publication, Grace provided a table of medications and their effects on sleep. He concluded that benzodiazepines have a similar effect to alcohol in limiting the ability of an occupant to awaken to a smoke alarm. Based upon his research, Grace (1997) concluded that “The more alcohol or drugs people use will cause longer stages of deep sleep which may leave the person in a comatose state.”

4. LANDSCAPE ANALYSIS

A review and analysis were conducted to characterize the healthcare payer landscape related to older adults, medications, and falls/fires. This task investigated the following components: a) the Center for Medicare and Medicaid Services (CMS) coverage of fall/fire prevention interventions, b) CMS quality indicators for health plans related to falls and injuries in older adults, c) commercial quality indicators for health plans related to falls, fires, and related injuries in older adults, d) emergency room data on falls and fires in older adults, e) years of life lost to fires and falls, and f) medical costs associated with fires and falls.

4.1 Center for Medicare and Medicaid Services (CMS) Coverage of Falls / Fire Prevention

Given the high incidence and prevalence of falls among older adults, CMS has made national coverage decisions, per the Affordable Care Act, aimed to decrease falls risk and encourage home safety. This section describes such coverage.

First, all Medicare beneficiaries are eligible for an Initial Preventative Physical Exam (IPPE) that must include screening for fall risk and home safety (CMS, 2021). Known as the “Welcome to Medicare” visit (HCPCS code G0402), the IPPE is an introduction to Medicare benefits and focuses on health promotion and disease prevention. The patient pays nothing; the Part B deductible and any co-payment are waived. The IPPE must be conducted by a Physician, Physician Assistant (PA), Nurse Practitioner (NP), or Certified Clinical Nurse Specialist (CCNS). It is not the same as a routine physical exam. The visit must take place
within the first year of enrollment and includes collection of the patient’s medical and social history, family history, and assessment of risk factors.

The items listed below relevant to falls and fires are included in the IPPE; education and counseling regarding identified risks must be provided (CMS, 2021).

- "Balance/gait Assessment - Medical records must include documentation of observed transfer and walking or use of a standardized scale (e.g., Get Up & Go, Berg, Tinetti) or documentation of referral for assessment of balance/gait.
- Postural blood pressure - Documentation of blood pressure values in supine and then standing positions.
- Vision Assessment - Medical records must include documentation that the patient is functioning well with vision or not functioning well with vision based on discussion with the patient or use of a standardized scale or assessment tool (e.g., Snellen) or documentation of referral for assessment of vision.
- Home fall hazards Assessment - Medical records must include documentation of counseling on home falls hazards or documentation of inquiry of home fall hazards or referral for evaluation of home fall hazards.
- Medications Assessment - Medical records must include documentation of whether the patient’s current medications may or may not contribute to falls."

In 2011, Medicare started including payment for one Annual Wellness Visit (AWV) per year after completion of the IPPE (CMS, 2021). As with the IPPE, there is no copayment or deductible for the AWV (HCPCS code G0438). The AWV must include a Health Risk Assessment (HRA) which takes about 20 minutes. If falls risk or home safety risks are detected, the provider should refer the patient to community-based intervention programs. Unfortunately, data from 2015 showed that 51.2% of practices who billed Medicare provided no AWVs (Ganguli, 2018).

Further, when a patient is discharged from the hospital or qualifies for home health care, Medicare Part B will pay for a home safety assessment, conducted in the home by a physical or occupational therapist. The assessment must be ordered by a physician. There are five categories relevant to fire safety (MedicareFAQ.com, 2021). Issues discussed include:

- Fire response – immediate action
- Exit procedures – is there a plan?
- Smoke detectors – are they installed and working?
- Fire extinguisher – do they have one? Does it work?
- Causes of fire and prevention- Are they understood?

Falls prevention is also part of the home safety assessment (MedicareFAQ.com, 2021). Home inspection includes:

- Stairs
- Throw rugs, runners
- Loose carpet
- Extension cords in walkways
- Oxygen tubing over 25 feet
- Clutter blocking walkways
- Pets that may cause a fall.
Some Medicare Advantage (MA) plans offer additional services related to falls prevention: MA plans are administered by private insurance companies (mainly United Healthcare, Humana, or Blue Cross / Blue Shield affiliates) that provide Part A and Part B services to Medicare beneficiaries. About one-third of Medicare beneficiaries are enrolled in these plans (Gondi, 2021). MA plans are capitated, meaning they are paid a lump sum from CMS for each enrollee, based on the enrollee’s expected healthcare costs. Thus, MA plans can provide additional services above those provided by standard Medicare.

Regarding falls and fires, MA plan providers may contract with community-based organizations to provide falls prevention and home safety education. MA plan benefits vary widely by insurance company, state, and county. During 2021 open enrollment in the U.S., there will be approximately 4,800 MA plans offering coverage, which is an average of 47 different plans per County (Connecticut Association for Healthcare at Home, 2021). A survey of these plans regarding home safety education and assessment benefits beyond those described above is beyond the scope of this project.

Additionally, the Bipartisan Budget Act of 2018 expanded the types of supplemental benefits that may be offered by MA Advantage Special Needs Plans (SNPs) that cover chronically ill enrollees. In addition to food, transportation, indoor air quality equipment, and other “non-medical” needs, MA SNPs now cover structural home modifications, as noted below (Coleman, 2019). Plans may establish a maximum plan benefit coverage amount for these supplemental benefits.

“Structural modifications to the home that may assist in the chronically ill enrollee’s overall function, health, or mobility are permitted if those items and services have a reasonable expectation of improving or maintaining the health or overall function of the chronically ill enrollee (e.g., widening of hallways or doorways, permanent mobility ramps, easy use door knobs and faucets).”

In 2018, the National Center for Health Statistics (NCHS) estimated that 23.9 % of adults aged 65 or older had one chronic disease and 63.7% had two or more chronic diseases (Boersma, 2012), making most of these older adults eligible for SNP plans. As of 2020, 3.3 million MA beneficiaries, or 14%, were enrolled in SNPs (Freed, 2020).

Finally, Medicare Part D, which covers prescription medications, has a benefit relevant to medication safety (CMS, 2021). Part D was implemented in 2006 and is optional for beneficiaries; plans vary in cost and specific medications covered. Part D enrollees who have multiple chronic diseases, are prescribed multiple medications, and are likely to incur medications costs that reach a specific threshold adjusted annually for inflation ($4,376 in 2021) must be enrolled in a Medication Therapy Management (MTM) program. The MTM includes a comprehensive medication review by a pharmacist or physician who meets with the patient (or caregiver if the patient is cognitively impaired) to discuss the reasons for each medication, how and when to take them properly, and any potential side effects or interactions. The patient or caregiver receives a written summary of the review and an action plan for best use of medication. If suggested by the health care provider, patient, caregiver, or Part D administrators, a copy of the plan is provided to prescribers in order to coordinate care.

4.2 CMS quality indicators related to falls and injuries in older adults

CMS quality measures are performance standards for all healthcare providers reimbursed by Medicare. The goal is to ensure effective, safe, efficient, patient-centered, equitable, and timely health care. Data is collected on processes, health outcomes, care coordination, and patient / caregiver experience. Table 1
below describes the CMS quality indicators for falls prevention for older adults. Official CMS specifications for these quality indicators are included as Appendix E.

Despite being eligible for an initial and annual falls assessment, as discussed in Section 4.1, patients with documentation of no falls or only one fall without injury in the past year are not included in the calculation of the quality measure on falls risk assessment.

### Table 1. 2021 CMS Quality Indicators, Falls Prevention, Ambulatory Care.

<table>
<thead>
<tr>
<th>Quality ID #154 (NQF #0101): Falls Risk Assessment, 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection type</td>
</tr>
<tr>
<td>Measure type</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Additional info.</td>
</tr>
<tr>
<td>Exceptions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality ID #155 (NQF 0101): Falls, Plan of Care, 2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection type</td>
</tr>
<tr>
<td>Measure type</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Additional info.</td>
</tr>
</tbody>
</table>

Importantly, CMS quality measures can encourage provider behavior through payment for performance. The Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) created the Quality Payment Program (QPP). The QPP allows clinicians to choose from two tracks based on their practice size, specialty, location, or patient population: the Merit-based Incentive Payment System (MIPS) or Advanced Alternative Payment Models (APMs). The MIPS is a CMS program measuring an eligible clinician’s performance and comparing it with their peers. Based on performance, clinicians receive a positive or negative Medicare payment adjustment. The adjustment is applied to the Medicare Part B payment two years after the performance period of the covered professional service. For example, the MIPS Total Score earned in 2020 (MIPS Year 4) will be applied to Medicare payments in 2022. In contrast, an Advanced APM offers a 5% incentive for achieving certain thresholds. If the provider achieves the required thresholds, they are excluded from the MIPS reporting requirements and payment adjustment.

CMS has also established quality indicators for enrollees receiving home health care that relate to medication and home safety, as displayed in Table 2 below. Outcome and Assessment Information Set
(OASIS) reporting to Medicare has been mandatory for home health agencies since 2007, per federal legislation (Abt Associates, 2019).

### Table 2. 2021 CMS Quality Indicators, Falls Prevention/Home Safety, Home Health Care.

<table>
<thead>
<tr>
<th>OASIS-D #M2016: Drug Education on All Medications</th>
<th>Outcome and Assessment Information Set (OASIS-D)</th>
<th>Process - Education</th>
<th>Percentage of episodes during which patient/caregiver was instructed on how to monitor the effectiveness of drug therapy, how to recognize potential adverse effects, and how and when to report problems.</th>
<th>None</th>
<th>Patient not on medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>OASIS-D #M2020 (NQF # 0176): Improvement in Management of Oral Medications</td>
<td>Outcome and Assessment Information Set (OASIS-D)</td>
<td>Outcome – Functional</td>
<td>Home health quality episodes where the value recorded on the discharge assessment indicates less impairment in taking oral medications correctly at discharge than at start (or resumption) of care.</td>
<td>None</td>
<td>Patient has no medications prescribed. Patient prescribed only IV or topical medications.</td>
</tr>
<tr>
<td>OASIS-D #J1800 and #J1900: Percent experiencing one or more falls with major injury</td>
<td>Outcome and Assessment Information Set (OASIS-D)</td>
<td>Outcome - health</td>
<td>Percentage of episodes in which the patient experiences one or more falls with major injury. Major injury is defined as bone fractures, joint dislocations, closed-head injuries with altered consciousness, or subdural hematomas.</td>
<td>Data is reported for two items. The first item asks whether the patient has experienced any falls since start of care (SOC)/resumption of care (ROC). If the answer is yes, the next item asks for the number of falls with a) no injury, b) injury (except major), and c) major injury. The measure is calculated using the number of falls with major injury.</td>
<td>Falls with no injury or minor injuries are not included in calculation.</td>
</tr>
</tbody>
</table>

In the past, CMS had an additional relevant home health agency quality indicator: "Multifactor Fall Risk Assessment Conducted For All Patients Who Can Ambulate (NQF #0537; OASIS Item M1910)". After considering public comment, CMS removed this item effective January 1, 2020.

### 4.3 Commercial quality indicators for health plans related to falls, fires, and related injuries in older adults

The Healthcare Effectiveness Data Information Set (HEDIS) was designed to provide purchasers and consumers with quality data, so they can accurately compare performance of private health insurance plans. Insurance plans can use the quality measures to see where they need to improve. HEDIS collects measures from commercial plans and Medicare Advantage plans. HEDIS measures related to falls,
including those associated with medication and home safety, are described in Table 3 below. There are no HEDIS measures related to fire safety.

### Table 3. HEDIS Measures Related to Falls and Home Safety, 2021.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care for older adults – Medication Review</td>
<td>Percentage of adults over 65 years who had medication review during measurement year</td>
<td>Review of all medications, including prescription medications, over the counter medications and herbal or supplemental therapies.</td>
</tr>
<tr>
<td>Care for older adults – Functional Status Assessment</td>
<td>Percentage of adults over 65 years who had functional status assessment during measurement year</td>
<td>Three of the following four must be assessed, using standard instruments: cognitive status; ambulation status; hearing, vision, and speech; other functional independence. Activities of Daily Living (ADLs) must be assessed. <strong>Falls assessment not required.</strong></td>
</tr>
<tr>
<td>Use of High-Risk Medications in the Elderly—At Least One High-Risk Medication</td>
<td>The percentage 65 years of age and older who have evidence of an underlying disease, condition, or health concern and who were dispensed at least one ambulatory prescription for a potentially harmful medication</td>
<td>Each of the three rates are reported separately and as a total: a) history of falls and a prescription for anticonvulsants, SSRIs, antipsychotics, benzodiazepines, nonbenzodiazepine hypnotics or tricyclic antidepressants; b) dementia and a prescription for antipsychotics, benzodiazepines, nonbenzodiazepine hypnotics, tricyclic antidepressants, H2 receptor antagonists or anticholinergic agents; c) chronic kidney disease and prescription for Cox-2 selective NSAIDs or non-aspirin NSAIDs.</td>
</tr>
<tr>
<td>Use of High-Risk Medications in the Elderly—At Least Two Different High-Risk Medications</td>
<td>The percentage 65 years of age and older who have evidence of an underlying disease, condition, or health concern and who were dispensed at least two ambulatory prescriptions for a potentially harmful medication</td>
<td>Same as above</td>
</tr>
<tr>
<td>Potentially Harmful Drug-Disease Interactions – History of Falls</td>
<td>The percentage 65 years of age and older with falls history who were dispensed an ambulatory prescription for a potentially harmful medication</td>
<td>Rate “a” above. Includes members who had an accidental fall or a hip fracture during measurement year.</td>
</tr>
</tbody>
</table>

### 4.4 Emergency department data

Several sources of data on emergency department visits due to falls and fires are available online. These data sets are described below, along with the statistics for emergency department visits among adults.
aged 65 or older. We report statistical estimates based on probability samples that reflect overall U.S. demographics. Where statistics are unstable (large confidence intervals) or not calculable due to small numbers, an asterisk is displayed. Estimates for deaths and injuries among U.S. adults aged 60-64 are provided in Appendix F, while estimates for Canadian adults aged 65+ are provided in Appendix G. The estimates in Appendix F and G are provided for informational purposes only and were not utilized for years of life lost (YLL) or medical costs calculations, as only the U.S. population of adults 65 and older was within the scope of Task 2.

4.4.1 Fires

Injuries from fires include both thermal burns and anoxia due to smoke inhalation. Data on emergency department visits for these injuries was obtained from the National Electronic Injury Surveillance System (NEISS). Operated by the U.S. Consumer Product Safety Commission (CPSC), NEISS collects data from a probability sample of U.S. hospital emergency departments, stratified by size and location. When a website user requests estimates for specified treatment dates, populations of interest, and source of injury, the corresponding national estimates(s) are calculated.

NEISS classifies burn injuries as either electrical, chemical, scalding, radiation, or thermal burns. Here we report thermal burns (NEISS diagnosis code 51) because electrical, chemical, scalding, and radiation burns are primarily occupational injuries and do not involve fires. Thermal burns are caused by fires or contact with a hot appliance (stove, heater, etc.) or other hot objects. We present data for all thermal burns, as contact burns are important to the NFPA’s Remembering When home safety program. A check of a records among persons age 65+ coded as “thermal burns” confirmed this, with the vast major describing incidents involving kitchen stoves or space heaters. 39.4% of thermal burns recorded in NEISS (raw data used for statistical estimates) did not involve a fire; however, the NEISS web site public interface does not allow for a national estimate of the number of non-fire-related thermal burns.

Table 4 displays the estimated number of older adults receiving emergency department treatment for thermal burns, by year and age group, for the past five years. The latest data available are from 2020. National estimates from NEISS are unstable and potentially unreliable when the estimate is less than 1,200 or the coefficient of variance is over 33%; this is the case for several years for ages 80 to 84 and all years for those age 85 or above (an asterisk is displayed). There were approximately 46,083 to 46,382 visits for thermal burns between January 1, 2016, and December 31, 2020, among adults aged 65 or older.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>3,140</td>
<td>2,810</td>
<td>3,353</td>
<td>4,247</td>
<td>3,436</td>
<td>16,986</td>
</tr>
<tr>
<td>70-74</td>
<td>2,337</td>
<td>2,529</td>
<td>2,111</td>
<td>2,247</td>
<td>2,211</td>
<td>11,435</td>
</tr>
<tr>
<td>75-79</td>
<td>1,546</td>
<td>1,790</td>
<td>1,645</td>
<td>1,549</td>
<td>1,562</td>
<td>8,092</td>
</tr>
<tr>
<td>80-84</td>
<td>1,308</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>1,430</td>
<td>5,227</td>
</tr>
<tr>
<td>85+</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>1,430</td>
<td>4,343</td>
</tr>
<tr>
<td>Total</td>
<td>9,141</td>
<td>9,170</td>
<td>8,748</td>
<td>9,807</td>
<td>9,516</td>
<td>46,083 - 46,382</td>
</tr>
</tbody>
</table>

In addition to thermal burns, many victims of residential fires present to the emergency department with anoxia caused by smoke inhalation. Anoxia (NEISS diagnosis code 65) is a form of severe hypoxia where there is an absence or deficiency of oxygen to the tissues. According to NEISS, the estimated number of
visits for anoxia for five-year groups is too unstable to calculate; thus, Table 5 displays the number of emergency department visits for anoxia for all adults aged 65 or older combined, by year, for the past 5 years. Data was limited to visits coded 1866, for residential fires, to exclude victims of carbon monoxide poisoning or suffocation, whether accidental or intentional.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-85+</td>
<td>1,855</td>
<td>1,452</td>
<td>1,831</td>
<td>2,147</td>
<td>2,226</td>
<td>9,511</td>
</tr>
</tbody>
</table>

### 4.4.2 Falls

Emergency department data on injuries due to falls comes from the CDC, National Center for Injury Prevention (NCIP). The CDC uses the same sampling frame used by NEISS, as described above. Table 6 displays the estimated number of U.S. emergency department visits due to falls, by year and age group, for persons aged 65 years and older. The latest data available is from 2019 (CDC, 2021a).

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>508,616</td>
<td>541,912</td>
<td>499,631</td>
<td>521,662</td>
<td>533,787</td>
<td>2,605,608</td>
</tr>
<tr>
<td>70-74</td>
<td>482,883</td>
<td>510,838</td>
<td>500,322</td>
<td>514,781</td>
<td>566,534</td>
<td>2,575,358</td>
</tr>
<tr>
<td>75-79</td>
<td>499,374</td>
<td>524,031</td>
<td>496,361</td>
<td>493,396</td>
<td>546,926</td>
<td>2,560,088</td>
</tr>
<tr>
<td>80-84</td>
<td>529,897</td>
<td>550,882</td>
<td>507,347</td>
<td>517,685</td>
<td>544,115</td>
<td>2,649,926</td>
</tr>
<tr>
<td>85+</td>
<td>1,016,780</td>
<td>1,047,752</td>
<td>967,059</td>
<td>949,173</td>
<td>952,174</td>
<td>4,932,938</td>
</tr>
<tr>
<td>Total</td>
<td>3,039,565</td>
<td>3,177,431</td>
<td>2,970,720</td>
<td>2,998,715</td>
<td>3,143,536</td>
<td>15,329,967</td>
</tr>
</tbody>
</table>

Approximately 3 million older adults per year or 15 million older adults over 5 years are treated in U.S. emergency departments for falls. It is important to note that over 25% of Americans aged 65 and over fall each year; however, less than half report the fall to their physician (Stevens, 2012). Table 6 reflects only those who sought emergency medical attention.

### 4.5 Years of life lost to fires and falls

To estimate the years of life lost (YLL) due to fires and falls, one must first obtain the number of deaths from these causes by age and year. Data on deaths was retrieved from the CDC’s National Center for Health Statistics, WONDER Online Database. The information in the CDC WONDER database originates from mortality data provided in the National Vital Statistics System. The cause of death in the database is as listed on the decedent’s death certificate.

Table 7 displays the number of deaths for adults aged 65 or older, coded as “Accidental exposure to smoke, fire and flames” (ICD-10 113 Cause List), by year and age group for the past five years. The latest year available was 2019. The numbers do not include suicides or homicides.
Table 7. Deaths from accidental exposure to smoke, fire, and flames, age 65+, 2015-2019.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>266</td>
<td>277</td>
<td>296</td>
<td>336</td>
<td>332</td>
<td>1,507</td>
</tr>
<tr>
<td>70-74</td>
<td>208</td>
<td>245</td>
<td>271</td>
<td>295</td>
<td>309</td>
<td>1,328</td>
</tr>
<tr>
<td>75-79</td>
<td>234</td>
<td>220</td>
<td>216</td>
<td>255</td>
<td>235</td>
<td>1,160</td>
</tr>
<tr>
<td>80-84</td>
<td>177</td>
<td>146</td>
<td>197</td>
<td>204</td>
<td>190</td>
<td>914</td>
</tr>
<tr>
<td>85+</td>
<td>222</td>
<td>210</td>
<td>239</td>
<td>249</td>
<td>217</td>
<td>1,137</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,107</td>
<td>1,098</td>
<td>1,219</td>
<td>1,339</td>
<td>1,283</td>
<td>6,046</td>
</tr>
</tbody>
</table>

Table 8 displays the number of deaths from accidental falls for the same years and age groups. The risk of dying from a fall increases with age. The number of deaths per year from accidental falls has increased steadily since 2016.

Table 8. Deaths from accidental falls, age 65+, 2015-2019.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>1,742</td>
<td>1,980</td>
<td>2,024</td>
<td>2,134</td>
<td>2,184</td>
<td>10,064</td>
</tr>
<tr>
<td>70-74</td>
<td>2,349</td>
<td>2,499</td>
<td>2,728</td>
<td>2,976</td>
<td>3,204</td>
<td>13,756</td>
</tr>
<tr>
<td>75-79</td>
<td>3,464</td>
<td>3,521</td>
<td>3,754</td>
<td>4,140</td>
<td>4,528</td>
<td>19,407</td>
</tr>
<tr>
<td>80-84</td>
<td>5,204</td>
<td>5,214</td>
<td>5,464</td>
<td>5,569</td>
<td>6,027</td>
<td>27,478</td>
</tr>
<tr>
<td>85+</td>
<td>15,727</td>
<td>14,154</td>
<td>16,760</td>
<td>17,703</td>
<td>18,359</td>
<td>82,703</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>28,486</td>
<td>27,368</td>
<td>30,730</td>
<td>32,522</td>
<td>34,302</td>
<td>153,408</td>
</tr>
</tbody>
</table>

YLL due to fires and accidental falls were estimated using the official actuarial table used by the U.S. federal government for 2017 (Appendix H), the most recent year available (Social Security Administration, 2021). The actuarial table displays the number of years of additional life a person of "x" years of age is estimated to have, for every age up to 118 years, by gender. According to the Social Security Administration, "the period life expectancy at a given age is the average remaining number of years expected prior to death for a person at that exact age, born on January 1, using the mortality rates for 2017 over the course of his or her remaining life." (SSA, 2021). For example, in 2017, the average 50-year-old American female was expected to live 33.23 more years.

Summing up the estimated remaining life expectancy for people dying in each age group, by gender, gives the results displayed in Table 9. As death data are available by five-year age group (rather than by individual age), this is a conservative estimate using the years of life remaining for the oldest age in each group. For example, for deaths among those aged 65 to 69, the years of additional life for age 69 was used. A spreadsheet displaying data and calculations is included as Appendix I.

Table 9. Estimated years of life lost due to fires and accidental falls, age 65+, 2017.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Fires</th>
<th>Falls</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>4,725</td>
<td>31,891</td>
</tr>
<tr>
<td>70-74</td>
<td>3,396</td>
<td>34,127</td>
</tr>
<tr>
<td>75-79</td>
<td>2,032</td>
<td>35,505</td>
</tr>
<tr>
<td>80-84</td>
<td>1,341</td>
<td>37,570</td>
</tr>
<tr>
<td>85+</td>
<td>1,158</td>
<td>83,493</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>12,652</td>
<td>222,587</td>
</tr>
</tbody>
</table>
4.6 Medical costs associated with fires and falls

Medical costs were calculated by the CDC’s Web-based Inquiry Query and Reporting System (WISQARS). WISQARS allows users to interactively produce estimates of the costs associated with injury-related deaths, hospitalizations, and emergency department visits (CDC, 2021b). Final cost estimates were produced by combining system-generated average (per case) cost estimates with user-entered data on medical treatment due to fires and falls by age group. The counts were entered using custom-generated data entry screens. The cost estimates come from the Pacific Institute for Research and Evaluation (PIRE), Calverton, MD; they are calculated by age group, injury cause (fire, fall), and by patient disposition (treated in the ED and released, hospitalized, or died). Costs are inflated to the most recent available year for cost data (2017).

The estimated number of emergency department visits are displayed in Tables 4, 5, and 6 presented earlier. Estimates of the percentage of non-fatal injuries that are treated in the emergency department and released along with the percentage that are hospitalized, by broad age group, were obtained from the Healthcare Cost and Utilization Project (HCUP) Nationwide Emergency Department Sample (NEDS), administered by the US Agency for Healthcare Research and Quality (AHRQ). The numbers are based on data collected by individual States and provided to AHRQ in 2017, the latest year available. The rates are displayed in Tables 10 and 11 below (HCUP, 2021).

Table 10. Disposition of non-fatal emergency department visits due to fires, aged 65+.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Treated &amp; Released</th>
<th>Hospitalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-84</td>
<td>82.4%</td>
<td>17.6%</td>
</tr>
<tr>
<td>85+</td>
<td>69.5%</td>
<td>30.5%</td>
</tr>
</tbody>
</table>

Approximately 57% of hospital admitted burns are treated in specialized burn centers (Lawrence, 2009).

Table 11. Disposition of non-fatal emergency department visits due to falls, aged 65+.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Treated &amp; Released</th>
<th>Hospitalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-84</td>
<td>75.9%</td>
<td>24.1%</td>
</tr>
<tr>
<td>85+</td>
<td>68.4%</td>
<td>31.6%</td>
</tr>
</tbody>
</table>

The percentages above were applied to the emergency department data displayed in Tables 4, 5, and 6, and the numbers were entered into the WISQAR system. The costs for the latest year with data available for calculations are displayed below in Table 12. The numbers do not include visits coded as attempts at suicide or homicide.

Table 12. Medical costs associated with emergency department visits and hospitalizations due to accidental falls and fires, age 65+, expressed in 2017 US dollars.

<table>
<thead>
<tr>
<th>Year</th>
<th>Treated &amp; Released</th>
<th>Hospitalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fires</td>
<td>2019</td>
<td>$13,980,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$199,117,000</td>
</tr>
<tr>
<td>Falls</td>
<td>2017</td>
<td>$8,947,462,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$40,892,724,000</td>
</tr>
</tbody>
</table>

WISQARS was also used to calculate medical costs due to deaths from fires and falls. Over half of deaths from fires are the result of smoke inhalation alone or smoke inhalation combined with burns (Ahrens,
2019); many victims are pronounced dead at the scene or on arrival at the hospital emergency department. Depending on the severity of injury and place of death, medical costs might include coroner, medical transport, emergency department, and inpatient care. Regarding falls, older adults can die if a fall results in head trauma or internal bleeding (Hartholt, 2019). Bone fractures may leave a patient bedridden, which may lead to further complications and death.

The number of deaths by year and age group from Tables 7 and 8 were entered into WISQARS. The medical costs associated with deaths from fires and falls in 2019, by age group, are displayed in Table 13 below.

### Table 13. Medical costs associated with deaths due to fires and falls, 2019, age 65+, expressed in 2017 US dollars.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Fires</th>
<th>Falls</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>$6,399,000</td>
<td>$65,008,000</td>
</tr>
<tr>
<td>70-74</td>
<td>$4,805,000</td>
<td>$84,143,000</td>
</tr>
<tr>
<td>75-79</td>
<td>$4,177,000</td>
<td>$126,309,000</td>
</tr>
<tr>
<td>80-84</td>
<td>$3,309,000</td>
<td>$174,639,000</td>
</tr>
<tr>
<td>85+</td>
<td>$2,893,000</td>
<td>$482,692,000</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>$21,583,000</strong></td>
<td><strong>$938,693,000</strong></td>
</tr>
</tbody>
</table>

### 5. CASE STUDIES

This section presents three fall case studies and seven fire case studies which highlight risk characteristics.

#### 5.1 Fall Case Studies

Three fall case studies are presented below to include the patient demographics, medical history, gait, strength, and balance assessment details, fall risk symptoms, and prescription and OTC medications. The case studies were obtained from the CDC Stopping Elderly Accidents, Deaths, and Injuries (STEADI) website, where each patient was assigned a fall risk score. A patient's fall risk score is calculated based upon their responses to the CDC STEADI's *Stay Independent* brochure checklist (Appendix C). Patients are asked about medication use, health conditions, and fall history. A score of 4 or greater, out of 14 indicates a fall risk. Each patient was assessed for gait, balance, and strength through three different tests. The timed up and go test has the patient start sitting in a chair, rise and walk to a line three meters away, and then return and sit back down in the chair. The strength test consists of having the patient complete as many rises out of a chair without using their hands as possible in 30 seconds. The balance test checks if the patient can hold a normal standing stance, semi-tandem stance, and full tandem stance for ten seconds each. Table 14 provides a summary of medications associated with each fall case study.

#### 5.1.1 Fall Case Study 1: 84-year-old, male

*Fall risk score: 4*

*Medical history:* The patient suffers from hypertension, L3-5 spinal stenosis, chronic low back pain, leg numbness/paresthesia, depression, benign prostatic hypertrophy with 3-4x/night nocturia and occasional incontinence, hyperlipidemia, gastroesophageal reflux disease, allergic rhinitis, glaucoma, and nummular eczema. He also has a B12 deficiency. The patient uses a cane to get around.
Gait, strength, and balance assessment: The patient’s gait has a slight shuffle, and it takes him 15 seconds to complete the timed up and go test with his cane. The patient can complete nine chair rises without using his arms. On the balance test, he loses his balance in the semi-tandem stance after 3 seconds.

Fall risk symptoms: The patient suffers from postural hypotension and is taking three medications that decrease blood pressure (valsartan, tamsulosin, finasteride). He is also taking four medications that may affect cognition (citalopram, gabapentin, cetirizine, trazodone). The patient also has poor vision and suffers from nocturia more than twice a night, depression, and incontinence.

Medications: Valsartan (80 mg daily), Citalopram (40 mg daily), Tamsulosin (0.8 mg daily), Finasteride (5 mg daily), Atorvastatin (40 mg daily), Omeprazole (20 mg daily), Cyanocobalamin (1000 mcg daily), Cetirizine 10 mg daily, Fluticasone (50 mcg/spray, two sprays each nostril daily), Gabapentin (600 mg 3x daily), Acetaminophen (500 mg-1000 mg up to 4x daily as needed), Brimonidine tartrate (0.15% one drop in both eyes 3x daily), Dorzolamide (2%/timolol 0.5%, one drop in both eyes 2x daily), Latanoprost (0.005% one drop, both eyes daily) Trazodone (50 mg daily), Calcium carbonate (500 mg up to 3x daily as needed)

Fall history: The patient lives in the apartment adjoining his son’s house. He uses a cane to get around outside. While the patient has not fallen before, he fears falling and becoming a burden to his family. As a result, he has started limiting his outside activities, even though he was previously social and outgoing. The patient has had intermittent dizziness when he stands up for the past year but cannot define any changes in his routine that could have caused it. Aside from dizziness, the patient also feels unsteady while walking and his son has noticed the patient teetering. The patient requires assistance while bathing.

5.1.2 Fall Case Study 2: 76-year-old, female

Fall Risk Score: 3

Medical history: The patient has poor vision, orthostatic hypotension, hypothyroidism, and stage 3 chronic kidney disease. She also suffers from a seizure disorder and schizoaffective disorder. She has urinary incontinence and nocturia more than twice a night.

Gait, strength, and balance assessment: It takes the patient 10 seconds to complete the timed up and go test. Her gait has decreased arm swing but is otherwise normal. She can complete 14 chair rises without using her arms and can hold the full tandem stance for 10 seconds.

Medications: Divalproex sodium DR (250 mg daily), Olanzapine (15 mg daily), Lorazepam (0.5 mg 2x daily), Levothyroxine (75 mcg daily), Docusate (200 mg daily), Acetaminophen (500 mg 4x daily)

Fall risk symptoms: The patient takes three psychoactive medications (divalproex, olanzapine, lorazepam). She also suffers from incontinence and poor vision.

Fall history: The patient lives independently in her own home and came to her primary care clinic for a wellness visit. On her self-assessment, she circled yes for having fallen in the previous six months and for taking medication to improve sleep or mood. The patient fell the previous week but did not seek treatment since she was not hurt. She had not previously fallen, has no fear of falling, and feels steady while walking. Walking is her only form of exercise.
5.1.3 Fall Case Study 3: 81-year-old, female

*Fall Risk Score = 9*

*Medical history:* The patient suffers from type 2 diabetes, coronary artery disease status post myocardial infarction, paroxysmal atrial fibrillation, congestive heart failure, hypertension, hypertriglyceridemia, depression, osteoarthritis of hips and knees, macular degeneration, rotator cuff syndrome, sciatica, diverticulosis, osteopenia, and gastroesophageal reflux disease. She also has a cognitive disorder that is not specified.

*Gait, strength, and balance assessment:* The patient’s gait is wide based with minimal hip extension and arm swing. She also has a markedly kyphotic posture. It takes her 18 seconds to complete the timed up and go assessment with her rollator walker. She is unable to rise out of a chair without using her arms. She loses balance in the semi-tandem stance after 4 seconds.

*Medications:* Novolog (3 units daily), Lantus (20 units daily), Lisinopril (20 mg daily), Metoprolol Succinate ER (200 mg daily), Spironolactone (12.5 mg daily), Furosemide (20 mg daily), Potassium Chloride (20 mEq daily), Digoxin (125 mcg daily), Fluoxetine (40 mg daily), Clonazepam (1 mg as needed), Atorvastatin (10 mg daily), Aspirin (81 mg daily)

*Fall risk symptoms:* The patient suffers from postural hypotension and is taking four medications that can lower blood pressure (lisinopril, metoprolol, spironolactone, furosemide). She suffers from cognitive impairment, and her depression is not controlled by her antidepressant. The patient takes two psychoactive medications (fluoxetine, clonazepam), but her other medications may need to be evaluated as well. The patient wears corrective lenses but still has poor vision with them. She also suffers from foot problems (numbness), incontinence, urinary frequency, and nocturia more than twice a night.

*Fall history:* The patient lived in an assisted living facility and came in for a routine follow-up. The week before, she had visited the hospital emergency room because she fell and hit the back of her head while getting out of the shower. She has previously fallen many times and is pessimistic about not falling. On her self-assessment, she checked yes for having fallen in the previous six months, using a cane or walker to get around, fear of falling, needing to use her hands to get out of a chair, having trouble stepping up a curb, rushing to use the restroom, and taking medication to improve her sleep or mood. The patient reports that she started falling around two years ago for no apparent reason. She falls indoors at any time of day. The patient has numbness in her feet and knee pain. While she used to attend exercise classes and go outside to walk, she no longer does either due to the pain and fear of falling. She also has a restless sleep and takes clonazepam to aid in sleep.

5.1.4 Fall Case Study Medication Comparison

Table 14 provides a summary of medications reported in each fall case study as well as the medication drug class and known side effects for each medication that potentially impacted fall risk. Analgesics, antihypertensives, antidepressants, anticonvulsants, benzodiazepines, and statins were reported in more than one case study.

For each medication, the known side effects, as listed on RxList.com, were reviewed. Side effects were identified as impacting fall risk if they had the potential to: (a) cause a loss of balance, (b) impair physical movement or coordination (c) impair vision, or (d) impair cognition.
### Table 14. Summary of Medication Found in Fall Case Studies.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Medications</th>
<th>Drug Class/Use</th>
<th>Known Side Effects Potentially Impacting Fall Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Valsartan ARB/Antihypertensive</td>
<td>Dizziness, lightheadedness, fainting, and vertigo</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Citalopram SSRI/Antidepressant</td>
<td>Dizziness and confusion</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tamsulosin alpha blocker/Antiadrenergic agent</td>
<td>Dizziness</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Finasteride 5-alpha reductase inhibitor/Antiandrogenic</td>
<td>None identified</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Atorvastatin Statin</td>
<td>Lightheadedness and fainting</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Omeprazole Protein Pump Inhibitor</td>
<td>Dizziness</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cyanocobalamin Vitamin</td>
<td>Dizziness, swelling, and numbness</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cetirizine Antihistamine</td>
<td>Rapid swelling</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Fluticasone Corticosteroid</td>
<td>Lightheadedness and vision changes</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Gabapentin Anticonvulsant</td>
<td>Dizziness, vertigo, lack of coordination, and vision changes</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Acetaminophen Analgesic</td>
<td>Dizziness and disorientation</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Brimonidine Ophthalmic glaucoma agent</td>
<td>Vision changes</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dorzolamide Ophthalmic glaucoma agent</td>
<td>Vision changes</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Latanoprost Ophthalmic glaucoma agent</td>
<td>Dizziness and vision changes</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Trazodone SARI/Antidepressant</td>
<td>Dizziness, confusion, disorientation, lack of coordination, fainting, and vision changes</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Calcium Carbonate Antacid/Mineral</td>
<td>None identified</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Divalproex Anticonvulsant</td>
<td>Dizziness, vision changes, loss of control of bodily movements, and thinking abnormal</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Olanzapine Antipsychotic</td>
<td>Dizziness and accidental injury</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Lorazepam Benzodiazepine</td>
<td>Dizziness, unsteadiness, confusion, disorientation, vertigo, loss of control of bodily movements, and vision changes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Levothyroxine Thyroid</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Docusate Laxative</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Acetaminophen Analgesic</td>
<td>Dizziness and disorientation</td>
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</tr>
<tr>
<td>3</td>
<td>Novolog Insulin</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>Lantus Insulin</td>
<td>None identified</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lisinopril ACE Inhibitor/Antihypertensive</td>
<td>Dizziness</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Metoprolol Succinate ER Beta Blocker/Antihypertensive</td>
<td>Dizziness, lightheadedness, confusion, and swelling</td>
<td></td>
</tr>
<tr>
<td>Drug</td>
<td>Category</td>
<td>Adverse Effects</td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------</td>
<td>----------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Spironolactone</td>
<td>Aldosterone Receptor Antagonist (ARA)/Antihypertensive</td>
<td>Dizziness and confusion</td>
<td></td>
</tr>
<tr>
<td>Furosemide</td>
<td>Diuretic/Antihypertensive</td>
<td>Dizziness and vertigo</td>
<td></td>
</tr>
<tr>
<td>Potassium Chloride</td>
<td>Mineral</td>
<td>None identified</td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>Antiarrhythmic</td>
<td>Dizziness and mental disturbances</td>
<td></td>
</tr>
<tr>
<td>Fluoxetine</td>
<td>SSRI/Antidepressant</td>
<td>Dizziness, lightheadedness, confusion, severe weakness, loss of coordination, feeling unsteady, and vision changes</td>
<td></td>
</tr>
<tr>
<td>Clonazepam</td>
<td>Benzodiazepine</td>
<td>Dizziness, abnormal coordination, loss of control of bodily movements, and confusion</td>
<td></td>
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<tr>
<td>Atorvastatin</td>
<td>Statin</td>
<td>Lightheadedness and fainting</td>
<td></td>
</tr>
<tr>
<td>Aspirin</td>
<td>Salicylate</td>
<td>None identified</td>
<td></td>
</tr>
</tbody>
</table>

### 5.2 Fire Case Studies

Seven fire case studies are presented below to include the decedent demographics, cause of death, medical history, drug use (e.g., prescribed, OTC, and illicit), and description of events. The case studies were obtained from fire death data collected from the Maryland Office of the Chief Medical Examiner, Maryland Office of the State Fire Marshal, and fire investigations conducted by Maryland local jurisdictions.

#### 5.2.1 Fire Case Study 1: 68-year-old, male

_Cause of death:_ Thermal burns and smoke inhalation

_Medical History:_ The decedent was restricted to the second floor of his house and used a walker. He had unspecified chronic health problems and back and leg problems.

_Positive drug tests:_ chlordiazepoxide (2.6 mg/L), citalopram (1.5 mg/L)

_Description of events:_ The fire occurred in the decedent’s house, a residential, 1- or 2- family dwelling with two stories. It started on the second floor in the bedroom at the end of the hallway that the decedent slept in. The decedent accidentally fell asleep with a lit cigarette in his mouth. The cigarette he was smoking was not and was not required to be compliant with the Maryland Fire Safe Cigarette Act. The decedent also had a history of falling asleep with lit cigarettes. At some point, the cigarette fell out of his mouth and onto the bed, which allowed the fire to grow. At some point, the decedent woke up to the fire, possibly due to the activation of his smoke alarm. He activated his LifeLine emergency alerting device at 9:48 am and stated, “My house is on fire, and I can’t get out.” He also attempted to egress but was unsuccessful. His body was found face up at the top of the second-floor stairs leading to the front door. By the time firefighters arrived at the scene, the decedent was unresponsive. Two firefighters dragged the decedent outside, and he was then transported to St. Mary’s Hospital. The decedent was pronounced deceased on arrival.
5.2.2 Fire Case Study 2: 76-year-old, female

*Cause of death:* Smoke inhalation

*Medical history:* None mentioned.

*Positive drug tests:* amitriptyline (0.2 mg/L), diltiazem (0.7 mg/L)

*Description of events:* The fire occurred in the decedent’s house, a residential, 1- or 2- family dwelling with two stories. It was started by an electric stove with a 220-volt cord located in the pantry in the kitchen on the first floor. There were combustible materials placed on top of the cord that ignited when the cord malfunctioned. The house was not equipped with smoke detectors or sprinklers. The decedent’s body was found in the front bedroom on the second floor with her head resting on the dresser at the foot of her bed. Her body had no thermal burns. She was pronounced deceased at the site of the fire.

5.2.3 Fire Case Study 3: 83-year-old, male and 72-year-old, female

*Cause of death:* Smoke inhalation and thermal burns

*Medical history:* The male decedent suffered from dementia. The female decedent wore a CPAP machine while she slept and walked with a cane.

*Positive drug tests:* olanzapine (0.2 mg/L) for male decedent, tramadol (0.1 mg/L) for female decedent

*Description of events:* The fire occurred at the decedent’s house, a two-story, residential, 1- or 2- family dwelling. It originated at the kitchen refrigerator, but the cause of ignition is unknown. The decedent’s home was a hoarding house, which allowed the fire to spread to the entire house quickly. The house had been secured, so firefighters had to force their way through. The narrow pathways also made entry more difficult. The decedents’ neighbors noticed and reported the fire to 911. The male decedent’s body was found in the kitchen. The female decedent was found in the bedroom at the second level. Both the decedent and his wife were pronounced deceased at the scene.

5.2.4 Fire Case Study 4: 85-year-old, female

*Cause of death:* Smoke inhalation and thermal burns

*Medical history:* None mentioned.

*Positive drug tests:* BAC of 0.08 g/dl, diphenhydramine (0.07 mg/L)

*Description of events:* The fire occurred in the decedent’s house, a residential, 1- or 2- family dwelling with two stories. The house only had one operational door out of six door openings. All other doors were obstructed or boarded up. The house was not equipped with sprinklers or fire detectors. The fire started on the first floor living room due to an overheated connection in the window air conditioner. The decedent was asleep on the living room couch and woke up to the fire. She first went to the second-floor bedroom to alert her daughter before egressing. The decedent made it to the kitchen, but the second floor collapsed on her. Her daughter managed to egress with minor burns. The decedent was pronounced deceased at the scene. Her body was found on the first floor under the debris.
5.2.5 Fire Case Study 5: 70-year-old, female

 Cause of death: Thermal burns and smoke inhalation

 Medical history: The decedent had a history of knee and back pain but was described as having the appropriate physical ability for her age. She also had arthritis and was described as a severe alcoholic. She was possibly taking Lipitor, a statin.

 Positive drug tests: BAC of 0.27 g/dl, tramadol (2 mg/L)

 Description of events: The fire occurred in the decedent’s house, a two story, residential, 1- or 2- family dwelling. The fire started from the stove, possibly due to an attempt to cook noodles. The decedent’s daughters mentioned that the decedent had previously caused a fire three years ago by using old bacon grease for cooking. The decedent noticed smoke coming from the stove and called in the fire at 4:08 pm. She attempted to egress but was unsuccessful. The decedent’s body was found ten feet from the door with her feet pointed towards the door. She was pronounced deceased at the scene. The neighbors did not hear any smoke detectors during the incident.

5.2.6 Fire Case Study 6: 65-year-old, female

 Cause of death: Thermal burns and smoke inhalation

 Medical history: The decedent was mobility impaired and used a walker and home oxygen.

 Positive drug tests: metoclopramide (0.2 mg/L), methadone (1.3 mg/L), amitriptyline (0.2 mg/L)

 Description of events: The fire occurred at the house the decedent was residing in, a single-story, residential, 1- or 2- family dwelling. The decedent suffered a medical emergency while smoking a cigarette and using home oxygen on the family room couch. At some point, her cigarette fell and ignited. The house’s smoke alarm activated, but the decedent did not or was not able to egress. Her body was found lying face down near the right side of the couch in the family room, where the decedent’s roommate had last seen her. Her head and hand were found near a trash bin containing ordinary combustibles and cigarette butts. That location is also where the home oxygen tubing would have terminated. She was pronounced deceased at the scene. The decedent had a history of falling asleep and burning herself with lit cigarettes.

5.2.7 Fire Case Study 7- 73-year-old, male

 Cause of death: Most likely thermal burns and smoke inhalation, the autopsy had not been received by the fire department.

 Medical history: The decedent had diabetes and mobility impairment. He had to use a cane and crutch.

 Positive drug tests: hydrocodone (0.06 mg/L), diltiazem (1.7 mg/L)

 Description of events: The fire occurred in the house that the decedent was residing in, a two-story, residential, 1- or 2- family dwelling. The house had hoarding conditions that made the egress paths difficult to traverse and allowed the fire to reignite and spread. The fire started in the kitchen, possibly due to the decedent’s attempt to bake cookies. The deceased’s body was found sitting on the kitchen
floor in front of a wooden chair, where his daughter had last seen him. He was pronounced deceased at the scene.

### 5.2.8 Fire Case Study Medication Comparison

Table 15 provides a summary of medications reported in each fire case study as well as the medication drug class and known side effects for each medication that potentially impacted fire risk. Alcohol, antihypertensives, antidepressants, and opioids were reported in more than one case study.

For each medication, the known side effects, as listed on RxList.com, were reviewed. Side effects were identified as impacting fire risk if they had the potential to: (a) increase the risk of having a fire (e.g., cooking or smoking with decreased inhibitions), (b) increase the risk of not awakening to an alarm, (c) lessen one's ability to perceive a threat and respond appropriately, or (d) efficiently move away from the threat.

#### Table 15. Summary of Medication Found in Fire Case Studies.

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Medications</th>
<th>Drug Class/Mode of Action</th>
<th>Known Side Effects Potentially Impacting Fire Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chlordiazepoxide</td>
<td>Benzodiazepine</td>
<td>Drowsiness, confusion, unusual changes in mood or behavior</td>
</tr>
<tr>
<td></td>
<td>Citalopram</td>
<td>SSRI/Antidepressant</td>
<td>Drowsiness, confusion, memory problems, blurred vision, and tunnel vision</td>
</tr>
<tr>
<td>2</td>
<td>Amitriptyline</td>
<td>Tricyclic Antidepressant</td>
<td>Drowsiness, fainting, severe confusion, disorientation, and blurred vision</td>
</tr>
<tr>
<td></td>
<td>Diltiazem</td>
<td>Calcium Channel Blocker/Antihypertensive</td>
<td>Tired feeling and fainting</td>
</tr>
<tr>
<td>3</td>
<td>Olanzapine</td>
<td>Antipsychotic</td>
<td>Drowsiness, confusion, unusual thoughts or behavior, memory problems, and blurred vision</td>
</tr>
<tr>
<td></td>
<td>Tramadol</td>
<td>Narcotic analgesic/Opioid</td>
<td>Drowsiness</td>
</tr>
<tr>
<td>4</td>
<td>Ethanol</td>
<td>CNS Depressant</td>
<td>Drowsiness, sleepiness, blackouts, confusion, reduced inhibitions, and memory loss</td>
</tr>
<tr>
<td></td>
<td>Diphenhydramine</td>
<td>Antihistamine</td>
<td>Drowsiness, confusion, and blurred vision</td>
</tr>
<tr>
<td>5</td>
<td>Ethanol</td>
<td>CNS Depressant</td>
<td>Drowsiness, sleepiness, blackouts, confusion, reduced inhibitions, and memory loss</td>
</tr>
<tr>
<td></td>
<td>Tramadol</td>
<td>Narcotic analgesic/Opioid</td>
<td>Drowsiness</td>
</tr>
</tbody>
</table>
6. CURRENT FALL & FIRE PREVENTION PROGRAMS & ORGANIZATIONS

This section presents current fall and fire prevention programs and organizations. An internet search was performed to identify current programs and in particular, current programs which address medication use and fall and fire risks.

6.1 Fall Prevention Programs & Organizations

A sample of seven fall prevention programs are presented below. Organizations managing these programs include the National Council of Aging (NCOA), the Centers for Disease Control and Prevention (CDC), the Midwest Roybal Center for Health Promotion and Translation, the Roybal Center at Boston University, and Project Enhance. Appendix B provides a summary table of these programs. In addition to the programs cited below, the Area Agencies on Aging is a resource which provides older adults access to fall prevention programs, amongst other things, at a local or regional level.

6.1.1 Fall Program 1: Falls Prevention for Older Adults

Organization: National Council of Aging (NCOA)

Website: https://www.ncoa.org/older-adults/health/prevention/falls-prevention

Target Audience: Older adults aged 55 years and older, caregivers of older adults, and healthcare providers working with older adults

Objectives: Aid all older adults in aging well by providing resources, tool kits, and assistance to professionals and older adults, and advocating to strengthen federal programs that aid in aging.

Methods: NCOA provides resources for older adults and healthcare providers on its website. Older adults can access articles on fall prevention facts and strategies, including articles that debunk fall-related myths and how to maintain physical health. In addition, the website recently started providing a free checkup modeled after CDC’s STEADI for older adults to see if they are at risk. It provides a list of evidence-based fall prevention programs that older adults can utilize and also provides the fall prevention stories of other older adults. NCOA also provides an Age Well tool to guide older adults in creating a plan for finances, Medicare, health, and wellness. For caregivers, the website provides resources on how to talk about fall prevention to older adults in addition to the previous resources. Healthcare professionals have access to articles on fall prevention outreach. NCOA also hosts a Falls Prevention Awareness Week to raise awareness nationwide on the preventability of falls.
**Recommendations**: Older adults should learn how to make their homes safer, exercise properly, and have routine health checkups. NCOA recommends practicing strength and balance exercises as a form of fall prevention. Older adults should also be aware of how to maintain their medication forms and where fire departments can aid in fall prevention. Caregivers should reach out to older adults to educate them on fall prevention. Healthcare professionals should promote falls prevention programs and awareness amongst their communities. NCOA encourages the use of community fall prevention programs, particularly evidence-based ones, and offers ways older adults can access these programs.

**Impacts/Results**: Over 4000 users completed the online fall risk checkup tool and had their results emailed to them since the tool was launched in 2020. Before the pandemic, NCOA was performing outreach programs in 49 states in 2019, with 300 million people reached through social media, grassroots campaigns, and traditional media. In 2020, the number dropped to 36 states, but they were able to reach 380 million people, of which 29.9 million were adults aged 55 years and older. While National Falls Awareness Day has been observed since 2007, NCOA led the resolution to expand it to National Falls Awareness Week, which was held for the first time from September 21st to September 25th in 2020. In 2019, NCOA was able to help screen 12,000 adults through grassroots efforts. During the pandemic, the number dropped to 6,520 adults.

### 6.1.2 Fall Program 2: MyMobility Plan

**Organization**: Centers for Disease Control and Prevention (CDC)

**Website**: [https://www.cdc.gov/transportationsafety/older_adult_drivers/mymobility/index.html](https://www.cdc.gov/transportationsafety/older_adult_drivers/mymobility/index.html)

**Target Audience**: Older adults aged 65 years and older.

**Objectives**: Aid older adults in remaining independently mobile as they age.

**Methods**: The MyMobility Plan is an online tool released in 2019 that is separated into three components: Myself, MyHome, and MyNeighborhood. Myself focuses on health management tips, MyHome addresses fall prevention via home safety, and MyNeighborhood develops a plan for travel within one’s own neighborhood. The tool can be completed by older adults on their own or with aid.

**Recommendations**: MyMobility recommends that older adults review their medication regimen with their healthcare provider, especially medications that could impair mobility. It also recommends that older adults get a physical checkup and eye exam every year to assess physical ability and vision through age. Older adults should also exercise regularly and perform balance and strengthening exercises at least three times a week. Regarding home safety, MyMobility recommends that there are no loose objects on the floor and that carpets, stairs, and handrails are stable. Items should be placed in easy reach when possible, and bright bulbs should be used for better visibility. MyMobility also recommends that older adults have a plan for transportation whenever they leave the house and that older adults should consider rideshare services if they feel unsafe driving.

**Impacts/Results**: No results available.
6.1.3 Fall Program 3: Older Adult Fall Prevention

*Organization:* Centers for Disease Control and Prevention (CDC)


*Target Audience:* Older adults ages 65 and older and the caregivers and healthcare professionals that work with them.

*Objectives:* Educate older adults on how to prevent falls and fall-related injuries as they age.

*Methods:* The CDC provides information on falls and injuries, including hip fractures. It also provides data on falls and fall-related deaths in older adults in the United States. There are also tips for what older adults can do to maintain their health and reduce their fall risk. Educational resources and publications are also made available on their website. The CDC also provides the *CDC Compendium of Effective Fall Interventions: What Works for Community-Dwelling Older Adults, 3rd Edition*, a list of effective fall interventions sorted by exercise, home modifications, clinical interventions, and multifaceted interventions. The compendium is primarily for those that want to address older adult falls in their community, including healthcare providers. They also provide a community-oriented guide on how to implement community-based fall programs.

*Recommendations:* The CDC recommends that older adults ask their doctors to evaluate their risk of falling, review their medications, and get their eyes checked. Additionally, older adults should ask about taking vitamin D supplements. Older adults can do strength and balance exercises and make home modifications, such as removing trip hazards or adding a railing to reduce fall risk as well. The compendium recommends for healthcare providers to learn how to identify and modify fall risks through home safety improvement, improving strength and poor vision, reducing risky behaviors, and providing psychological support. The guide on forming a community-based fall program provides information on how to plan for and select an appropriate fall program, as well as how to maintain the program through partnerships, promotion, awareness. It provides suggestions on how to implement and evaluate a community-based program.

*Impacts/Results:* No results available.

6.1.4 Fall Program 4: Stopping Elderly Accidents, Deaths, and Injuries (STEADI)

*Organization:* Centers for Disease Control and Prevention (CDC)

*Website:* [https://www.cdc.gov/steadi/](https://www.cdc.gov/steadi/)

*Target Audience:* Community dwelling older adults ages 65 years and older and healthcare providers working with these adults.

*Objectives:* Identify patient fall risk, modifiable fall risk factors, and provide interventions to reduce fall risk.

*Methods:* CDC STEADI provides resources to both older adults and healthcare providers. STEADI’s website includes information on how older adults can reduce their fall risk and eliminate fall hazards. It also provides online continuing education for healthcare providers and specific training for pharmacists to
identify fall risk-inducing drugs. Providers are also given algorithms and video examples on how to conduct a comprehensive fall risk assessment, including a standardized gait, strength, and balance assessment. The CDC is also in the process of integrating STEADI with electronic health records (EHR) to provide a more comprehensive fall risk assessment.

**Recommendations**: STEADI recommends an initial multifactorial fall risk assessment and yearly reassessments. In this assessment, providers should conduct a physical exam, evaluate gait, strength, and balance, and address modifiable and/or treatable risk factors. If needed, an evaluation should be conducted by a mental health specialist to assess the need for any behavior and/or alcohol and drug-related interventions. Providers should also assess whether the patient has any foot or vision-related issues. A review of the patient’s comorbidities and medications should be done as well. The patient’s home environment should be checked for any fall risk increasing hazards. STEADI suggests that after being assessed, patients should be provided with information on home safety and the local exercise and fall prevention programs. It also recommends that healthcare providers conduct a follow-up within 30 to 90 days.

**Results**: STEADI has been integrated into the Oregon Health and Science University (OHSU), the Rees Jones Trauma Center located in Dallas, Texas, and Mercer University located in Georgia. OHSU initially implemented STEADI in their internal medicine and geriatrics departments in 2011 and later into their family medicine practice. STEADI’s algorithm was integrated into their initial screening process for all patients 65 years and older. This allowed OHSU to screen over 45% of eligible patients in a month. STEADI’s EHR tool also allowed providers to assign fall-related codes so they could proactively identify high-risk patients and intervene properly.

At the Rees Jones Trauma Center, STEADI was implemented in 2012 by creating an injury flowsheet in each patient’s EHR, allowing the staff to collect data on the fall situation, such as the location and height of the fall in addition to identifying at-risk patients. Over the course of two years, 2,784 older adult patients were admitted, with 62% of older adult patients having sustained falls. Before implementing STEADI, the average duration of stay was 7.9 days with 46.8% of patients discharged home. 1.5% of patients returned to the trauma center with another fall. However, in the first year, the average length of stay decreased to 6.5 days with the percentage of patients being discharged home increasing to 54.5%. The percentage of patients returning with another fall decreased to 0.6%. The next year, the average length of stay decreased to 5 days at the hospital with 63.6% of patients discharged home.

Mercer University integrated STEADI into the Department of Physical Therapy as part of the Patient/Client Management course taught by Dr. David Taylor in 2013. The students were required to complete CDC’s STEADI Older Adult Fall Prevention Online Training for Providers and apply STEADI practically at the Shepherd Center. After three years, 114 students had been trained to use STEADI and 76 had completed the online course. Additionally, Dr. Taylor brought together a group of students from the nursing, public health, physical therapy, pharmacy, and physician assistant departments to discuss fall prevention using CDC STEADI.

### 6.1.5 Fall Program 5: Fit & Strong

**Organization**: Midwest Roybal Center for Health Promotion and Translation

**Website**: [https://www.fitandstrong.org/](https://www.fitandstrong.org/)

**Target Audience**: Older adults with arthritis and their caregivers
Objectives: Help people with osteoarthritis learn how to exercise properly and gain a better understanding of how physical exercise can help manage arthritis symptoms. Maintain independent functioning for older adults with osteoarthritis.

Methods: The program meets three times a week for eight weeks. Participants are guided through flexibility exercises, fitness walking and other low impact aerobics, and resistance training by a certified trainer for an hour. The last thirty minutes are spent creating a management plan for arthritis. Before the program ends, trainers will also meet with each participant individually to create a physical activity plan that they can follow after the program ends. Fit & Strong also provides a certification program for those interested in becoming trainers and another class to become a master trainer who oversees other trainers. Their website also provides resources for those interested in offering Fit & Strong in their community.

Recommendations: Older adults should regularly perform flexibility, aerobic, and strength training exercises, even after the program ends. They should adhere to the individual physical activity plan created at the end of the program. Older adults should have a good understanding of why these exercises are beneficial for managing osteoarthritis and the science behind each exercise.

Impacts/Results: The program is offered in eight states. Participants saw a significant increase in self-efficacy for exercise and exercise participation. There was also a decrease in lower extremity stiffness and pain over the periods of two, six, and twelve months. Participants had significant increases in physical activity, lower extremity function, and mobility in conjunction to decreased depression and anxiety. These benefits persisted for eighteen months after the program. Fit & Strong received the Healthcare and Aging Award in 2008 for its innovation and significant impact on the community, and the Archstone Foundation Award for Excellence in Program Innovation in 2006 for effectively applying academic theory to the program.

6.1.6 Fall Program 6: A Matter of Balance

Organization: Roybal Center at Boston University

Website: https://www.mainehealth.org/healthy-communities/healthy-aging/matter-of-balance

Target Audience: Older adults aged 60 and older living in a community and their caregivers

Objectives: Learn that the fear of falling is controllable. Set goals to increase activity and reduce controllable fall risk factors at home. Learn exercises that increase balance and strength and continue to practice them after the program ends.

Methods: Older adults attend eight two-hour sessions in groups of eight to twelve so they can better understand falls and fall risk factors and learn exercises for fall prevention. The sessions are led by two certified coaches and involve group discussion, problem-solving, skill-building, assertiveness training, and sharing practical solutions in addition to exercise training. A guest healthcare professional is also invited to attend the program during one of the sessions to address questions on falls and reducing fall risks. A Matter of Balance has also been adopted into an online format that requires nine two-hour sessions, instead of eight. The program also provides training for volunteers to become coaches. Coaches can also become lead trainers or master trainers that are allowed to train more coaches and further spread the program.
Recommendations: Older adults should learn what contributes to increased fall risk and take steps to reduce those factors, including exercising to build balance and strength and home modification. They learn chair exercises and those that target the shoulders, toes, ankles, and legs. The program recommends home modifications such as removing trip hazards in walkways and using tub chairs and rug grips. Older adults should learn how to develop an action plan to address fall risk factors, continue exercising, and control fear of falling. They also learn how to maintain proper posture while sitting, standing, and walking and how to fall safely.

Impacts/Results: The program is offered in 41 states, the District of Columbia, and British Canada. 97% of participants are more comfortable with talking about fear of falling and increasing their home activity and 99% plan on continuing to exercise. A 2013 CMS report estimated that the program saved $938 in total medical costs per year by reducing costs in unplanned hospital visits, nursing facility costs, and home health costs.

6.1.7 Fall Program 7: Enhance Fitness

Organization: Project Enhance

Website: https://projectenhance.org/enhancefitness/

Target Audience: Older adults and their caregivers

Objectives: Promote a physically active lifestyle in older adults to provide social interaction, reduce falls and fall risk factors, and empower an independent lifestyle.

Methods: Enhance Fitness provides an ongoing one-hour class of up to twenty-five participants led by a certified instructor. The class consists of a five-minute warm up, twenty minutes of aerobics, five minutes of cool-down, twenty minutes of strength training, and ten minutes of flexibility exercises. The program also provides training for those interested in becoming certified instructors and resources for those interested in providing Enhance Fitness. To maintain efficacy, there is also a web-based data collection system available.

Recommendations: Older adults should practice both dynamic and static exercises to improve strength, balance, and flexibility. Strength training involves exercises with soft cuff weights up to twenty pounds on the arms and legs. Older adults should also eat cleanly in accordance with their instructor’s recommendations. The class is also an opportunity for older adults to make new friends and create a support group.

Impacts/Results: Participants saw an improvement in physical function and a decrease in depression, medical care costs, unplanned hospitalizations, and mortality rates. The pilot study done in 1993 in Washington state showed a 13% improvement in social function, a 35% improvement in physical function, and a 52% improvement in depression. A CMS report from 2013 estimated a $945 reduction in total medical costs.

6.2 Fire Prevention Programs & Organizations

A sample of seven fire prevention programs are presented below. Organizations managing these programs include the United States Fire Administration (USFA), Centers for Disease Control and Prevention (CDC), Electrical Safety Foundation International (ESFI), Scottsdale Fire Department,
Huntington Beach Fire Department, Montgomery County Fire and Rescue Service (MCFRS), and Massachusetts Department of Fire Services. Appendix D provides a summary table of these programs.

6.2.1 Fire Program 1: Fire is Everyone’s Fight (FIEF)

Organization: U.S. Fire Administration (USFA)

Website: https://www.usfa.fema.gov/prevention/outreach/fief/

Target Audience: Fire departments, life safety organizations, and fire and life safety professionals.

Objectives: To unite the fire service, life safety organizations and professionals to reduce home fire injuries, deaths and property loss by changing how people think about fire and fire prevention.

Methods: In addition to other target audiences, the program provides fire safety outreach materials specific to older adults for fire departments and other partnering organizations to distribute and use for public education. Materials include handouts, public service announcements, videos, posters, and pictographs. A Fire is Everyone’s Fight logo is made available for use by fire departments and agencies in public service announcements, advertisements, promotions, and educational materials for fire safety.

Recommendations: The USFA recommends that older adults develop and practice a home escape plan, install, and maintain smoke alarms, control ignition sources around medical oxygen, and take special precautions with smoking, cooking, and heating the home. It also recommends caregivers of older adults take an active role in ensuring the fire safety of the elderly they are responsible for.

Impacts/Results: The Springfield, Illinois, Fire Department placed a “Smoke Alarms Save Lives” message along with the FIEF logo on the sides of city buses. The West Hartford, Connecticut, Fire Department posted a FIEF public service announcement on the importance of smoke detectors at the Bradley International Airport. The Greenville, South Carolina, City Fire Department has a FIEF public service announcement at bus stops to promote safe cooking.

6.2.2 Fire Program 2: Fire Safe Seniors Program

Organization: Centers for Disease Control and Prevention (CDC) and the U.S. Fire Service Administration (USFA)

Website: https://www.usfa.fema.gov/prevention/outreach/fire_safe_seniors.html

Target Audience: Organizations that serve seniors at the national, state or community level, such as fire departments, meal delivery programs, home companion groups, and senior center associations.

Objectives: To help organizations plan and implement fire safety interventions for the high-risk group of older adults.

Methods: The program provides resources such as an implementation guide, training curricula for staff, home assessment tools, and educational handouts to assist organizations with implementation of fire safety interventions for older adults.

Recommendations: The Fire Safe Seniors Program focuses on four elements for organizations to implement in their fire safety interventions for older adults; Home assessments to evaluate the need for smoke detectors and fire hazards, smoke detector installation, in-person education sessions for older...
adults and their families, and follow ups to determine if alarms are working, assess changes in individuals’ fire safety knowledge, attitudes, and behaviors, and see if fires have occurred.

*Impacts/Results:* No results available.

### 6.2.3 Fire Program 3: Home Fire Safety for Older Adults

*Organization:* Electrical Safety Foundation International (ESFI)


*Target Audience:* Older adults and their families.

*Objectives:* To provide tools to educate older adults and their families nationwide about home fire hazards related to cooking, heating, and electrical equipment. The importance of smoke alarms and fire escape planning are also reinforced.

*Methods:* The program provides educational resources such as public service announcements, community outreach presentations, and fire safety tips documents. The program resources were developed with funds provided by an FY 2011 Fire Prevention and Safety grant from the U.S. Department of Homeland Security’s Federal Emergency Management Agency as part of a multi-generational fire safety awareness campaign.

*Recommendations:* ESFI encourages older adults to take a proactive approach to home fire safety by learning about potential fire hazards, specifically associated with cooking, heating, and electrical equipment, and how to prevent them. They recommend that families and caregivers help older adults review the fire safety information and/or perform their smoke alarm maintenance activities and home fire safety check-ups. The program emphasizes that everyone needs to have a family fire escape plan, and this should be updated regularly to address changes that may come from aging such as reduced senses and mobility. Recommendations for a good fire escape plan include; Considering whether older adults should sleep in a room on the ground floor to make escape easier, checking all exits to ensure walkers or wheelchairs can fit, making necessary accommodations such as providing exit ramps or widening doorways, assigning a family member to assist older adults with escape, and contacting the local fire department to explain special needs for fire escape planning and asking them to keep this information on file.

*Impacts/Results:* No results available.

### 6.2.4 Fire Program 4: Home Safe Home

*Organization:* Scottsdale, AZ Fire Department

*Website:* [https://www.scottsdaleaz.gov/fire/home-safe-home](https://www.scottsdaleaz.gov/fire/home-safe-home)

*Target Audience:* Seniors and individuals living with disabilities.

*Objectives:* To help keep older adult residents safer in their homes.

*Methods:* The program offers free home evaluations, conducted by trained fire department representatives, for seniors. The evaluations cover both fire safety and fall prevention in the home and include review of smoke alarms, fire extinguishers, exit drills, and potential fire hazards.
Recommendations: The Scottsdale Fire Department recommends utilizing EDITH (Exit Drills in the Home) for each frequently used room, checking that windows and doors are available for safe egress, and learning to shelter-in-place when egress is not possible.

Impacts/Results: No results available. None found.

6.2.5 Fire Program 5: Senior Home Inspection Program (Project SHIP)

Organization: Huntington Beach, CA Fire Department

Website: [https://www.huntingtonbeachca.gov/government/departments/Fire/Education_Programs/ProjectSHIP/ProjectSHIPIcm](https://www.huntingtonbeachca.gov/government/departments/Fire/Education_Programs/ProjectSHIP/ProjectSHIPIcm)

Target Audience: Huntington Beach, CA residents 60 years and older.

Objectives: To protect, support, and assist senior citizens in fire safety, burn prevention, accident prevention, earthquake preparedness, and home security through individual education.

Methods: The program trains volunteers to provide home fire safety inspections and install free smoke detectors to residents 60 years and older. Smoke detectors and batteries are donated by the local business community.

Recommendations: The Huntington Beach Fire Department recommends residents over 60 years old request free home fire safety inspections and have combo detector/carbon monoxide detectors installed.

Impacts/Results: No results available.

6.2.6 Fire Program 6: Senior Outreach Program

Organization: Montgomery County, MD Fire and Rescue Service (MCFRS)

Website: [https://www.montgomerycountymd.gov/mcfrs-info/tips/seniors/index.html](https://www.montgomerycountymd.gov/mcfrs-info/tips/seniors/index.html)

Target Audience: Seniors and individuals living with disabilities.

Objectives: To reduce fire loss across the County and to enhance public awareness about fire and life safety issues.

Methods: The program offers educational resources online and provides community outreach services targeted to seniors. It also provides free home safety checks and smoke alarm installations to high-risk individuals that include senior citizens, individuals with disabilities or impairments and economically challenged residents.

Recommendations: MCFRS recommends that seniors reduce their risk of dying or being injured in a fire by checking smoke detectors, practicing fire drills at home, deciding who will help family members that may need assistance in an evacuation, keeping a pair of slippers, eyeglasses and a flashlight by the bed at night, and putting cigarettes or cigars out at the first sign of feeling drowsy while watching television. MCFRS also provides tips for family and friends of older adults and recommends that these people complete a fire safety check of the elderly’s home. The home fire safety check includes checking smoke detectors, checking for scorch marks on pots and pans, checking that clothing, bedding, furniture, and
floors are free of cigarette burns, and discussing with the elderly person any fire hazards or safety deficiencies that are found.

*Impacts/Results:* Per the MCFRS Program appraisal template for Fessam category 5, between July 2015 and June 2019, the program conducted over 2,000 home safety checks, installed 2,331 smoke alarms, and provided outreach and fire and life safety programs to over 200 senior programs with an audience of 7,197 residents ages 55 and older.

### 6.2.7 Fire Program 7: Senior SAFE Program

**Organization:** Massachusetts Department of Fire Services

**Website:** [https://www.mass.gov/service-details/senior-safe-program](https://www.mass.gov/service-details/senior-safe-program)

**Target Audience:** Massachusetts fire departments and agencies that serve seniors.

**Objectives:** To provide fire and life safety education to seniors for them to recognize the dangers of fire, poisoning, falls and other medical emergencies including the fire hazards that smoking related materials pose. And to create community partnerships and collaborate with the purpose of improving fire and life safety in the homes of seniors.

**Methods:** The program provides grants to local fire departments to teach fire and life safety to seniors in their communities and creates partnerships between these fire departments and agencies that serve seniors. It is administered by the state Department of Fire Services and grant funds are provided through the Executive Office of Public Safety and Security. Fire departments are required to apply for the program’s grants each year and applications must include community demographics, mission statement, budget and program narrative, and signatures from the involved fire departments and senior agencies.

**Recommendations:** The Senior SAFE Program emphasizes that education is key to improving the safety of seniors at home. It also includes initiatives to improve safety in senior housing including smoke and carbon monoxide alarm installation, testing, and replacing batteries, installation of house numbers, use of heating limiting devices on stoves, installation of in-hood stove fire extinguishers, and use of nightlights.

*Impacts/Results:* No results available.

### 7. SUMMARY OF FINDINGS

The goal of this research was to identify associations between medication use and fall and fire risks in older adults. The research project included four tasks: (a) a literature review on medication use and its relationship to fall and fire risks in older adults, (b) a characterization of the healthcare payer landscape related to older adults, medications use, and falls, (c) a presentation of case studies related to medications and risk factors for falls/fires, and (d) a presentation of fall and fire prevention/intervention programs currently being used in the field. A summary of findings is presented below.

Regarding demographic factors associated with falls, the following can be concluded from the literature review:

- Approximately 43% of unintentional injuries in older adults resulted from falls. Falls and fall-related injuries increased with age with the highest rate present in adults 85 years and older and those with poor self-reported health.
Fall rates were highest in males, Native Americans/Alaskan Natives, and older adults living in rural areas, although males had a lower fall-injury rate.

Fall-related ED visits increased over time and the most significant rise in ED visits occurred in adults 75-84 years, Caucasians, females, and patients from the southern region of the U.S. (as defined by the U.S. Census).

Fall mortality rates increased over time and were highest in males, Caucasians, adults 85 years and older, and older adults living in small metro areas.

Regarding demographic factors associated with fires, the following can be concluded from the literature review:

- Deaths rates increased with advanced age for all races and ethnicities and adults aged 85 years and older had the highest occurrence of deaths.
- Adults aged 45 and older made up 45% of fire-related injuries and 67% of fire-related deaths. Adults 50 to 54 years old had the highest occurrence of injuries.
- In adults aged 55 and older, death rates were notably higher for African Americans/Blacks and Native Americans/Alaska Natives.
- Men and Caucasians were more likely to suffer from burns. (Note: Not specific to older adults)

Regarding general trends in medication use in older adults (i.e., not specific to falls and fires), the following can be concluded from the literature review:

- Cannabis use has increased in both genders, all races, in those with chronic diseases and mental illness, in users of alcohol and tobacco, and cannabis is the most commonly used drug that is considered illicit in some states.
- In adults 45-64 years old, approximately 67% used at least one prescription medication, approximately 37% used at least three or more, and approximately 18% used at least five or more. In adults 65 and older, approximately 89% used at least one prescription medication, approximately 66% used at least three or more, and approximately 42% used at least five or more.
- Alcohol was the most abused substance amongst older adults and approximately 11% of older adults were binge drinkers. Men, tobacco or cannabis users, and Non-Hispanic African Americans were more likely to binge drink. Approximately 54% of adults 45-64, 45% of adults 65-74, and 33% of adults 75 and older were current regular alcohol users.
- Concurrent use of alcohol and alcohol interacting medications in older adults ranged from 21 to 35%. Concurrent use of alcohol and psychotropic drugs in older adults is about 7.5%.
- Prescription medication use and polypharmacy increased over time while there was a decrease in potentially inappropriate medication use. Women, adults taking multiple medications, adults with increased healthcare facility visits, and individuals living in the south, had a higher association with inappropriate medication use.
- Over 34.0% of older adults had at least one drug interaction and approximately 25% had one or more drug-drug interactions. Approximately 15% of older adults were at risk for a potential major drug-drug interaction. NSAIDs were the most common drug class negatively affecting other drugs, whereas cardiovascular agents were the most affected drug class by use with other drugs.
- Older adults with a history of falls or fractures were the second most likely group to experience drug-disease interactions, with benzodiazepines being the most common affecting drug.
- Antihypertensives were the most used drug class. OTC analgesics, such as aspirin and naproxen, were the second most commonly used drug class. Benzodiazepines were the most commonly prescribed psychoactive drug.
Regarding medication use and falls, the following can be concluded from the literature review:

- Approximately 44% of older adults were using a minimum of one fall related drug. Women, adults aged 70-79 years old, Caucasians, and adults from Southern states were more likely to use fall-related drugs.
- Adults using sleep medication (e.g., non-benzodiazepine hypnotics) reported more falls than non-users, with prescription medications having a greater effect than OTC medications.
- Antidepressant medication use accounted for 19% of the association between major depressive disorder and falls and 18% of the association between major depressive disorder and fall-related injuries.
- The highest percentage of falls was reported by adults using SNRIs (42%), and the risk of falling increased by 30% in adults taking SSRIs or SNRIs.
- Approximately 64% of adults reported alcohol consumption with concurrent use of alcohol and CNS drugs resulted in an absolute fall risk of 19% and absolute injurious fall risk of 8%.
- Antidepressants, neuroleptics and antipsychotics, benzodiazepines, sedatives and hypnotics, antihypertensive agents, nonsteroidal anti-inflammatory drugs (NSAID), diuretics, β blockers, and narcotics were identified as fall risk increasing drugs.
- Antipsychotics, benzodiazepines and nonbenzodiazepines (e.g., insomnia drugs or z-drugs) cause an increased risk of cognitive impairment, falls, and fractures.
- Older adults with fall and fracture history should avoid antiepileptics, antipsychotics, benzodiazepines, nonbenzodiazepines, antidepressants, and opioids.
- Older adults taking three or more drugs classified as antidepressants, antipsychotics, antiepileptics, benzodiazepines, nonbenzodiazepines, and opioids have an increased fall risk.
- Contrary to the conclusions of other researchers, one study found no association between fall risk and alcohol, antiepileptics, antipsychotics, and antihypertensive use. Another study found no strong evidence of association between falls, recurrent falls, and injurious falls and antihypertensive use.
- Although the literature review indicated that cannabis use in older adults is on the rise, no studies were found which assessed cannabis use and fall risk.

Regarding medication use and fires, the following can be concluded from the literature review:

- A person’s ability to awaken to an audible alarm was significantly reduced when the subject consumed alcohol.
- Sleep medications, alcohol, and marijuana are likely to impact arousal threshold.
- Hypnotic drugs raised the auditory threshold in older adults by 9 dBA.
- Approximately 50% of the subjects using a benzodiazepine drug did not awaken to the first alarm signal, while all the placebo subjects did awaken. Benzodiazepines have a similar effect to alcohol in limiting the ability of an occupant to awaken to a smoke alarm.
- Those intoxicated or on drugs are part of a susceptible population that does not “fully benefit” from traditional smoke alarm technology.
- Approximately 76% of decedents had alcohol and/or drugs in their system and approximately 53% of decedents over the age of 18 had a BAC greater than 0.10%.
- Approximately 74% of older adult fatalities were smokers and 64% were problem drinkers.
- Those with physical or cognitive disabilities, impaired by alcohol or drugs, and/or 64 years and older were more likely to die in a fire.
- The most frequently found drugs in decedents were antidepressants, benzodiazepines, non-opioid analgesics, hypnotics, and opioids. (Note: not specific to older adults)
- Of the decedents tested for drugs, approximately 46% tested positive. Detected drugs included pain relievers and benzodiazepines. (Note: not specific to older adults).
• An average of 1.5 psychotropic drugs were found in decedents that tested positive for drugs. (Note: not specific to older adults)
• Hypnotic/sedative drugs were found in 29% of decedents and antidepressants were found in 10% of decedents (Note: not specific to older adults).

Regarding the healthcare landscape, the following can be concluded:
• All Medicare beneficiaries are eligible for an Initial Preventative Physical Exam (IPPE) that must include in-office screening for fall risk and home safety. The same screening should be included in an Annual Wellness Visit (AWV) each year thereafter. If falls risk or home safety risks are detected during the visit, the provider is instructed to refer the patient to community-based intervention programs. Unfortunately, data from 2015 indicate that 51.2% of practices that billed Medicare provided no AWVs.
• When a patient is discharged from the hospital or qualifies for home health care, Medicare Part B will pay for a home safety assessment which covers issues related to fire safety and fall prevention. This visit must be ordered by a physician.
• Some Medicare Advantage (MA) plans offer additional services related to falls prevention. For example, some MA Advantage Special Needs Plans (SNPs) that cover chronically ill enrollees cover home modifications that aid in reducing fall potential.
• Medicare Part D enrollees who have multiple chronic diseases, are prescribed multiple medications, or are likely to incur medications costs that reach a specific annual threshold must enroll in a Medication Therapy Management (MTM) program which includes a comprehensive medication review by a pharmacist or physician.
• There are two CMS quality indicators related to ambulatory care and fall prevention and three CMS quality indicators related to home health care and fall prevention / home safety.
• The Healthcare Effectiveness Data Information Set (HEDIS), the commercial quality indicator program, has five measures related to falls and home safety.
• There were approximately 46,083 to 46,382 visits for thermal burns between January 1, 2016, and December 31, 2020, among adults aged 65 or older.
• There were approximately 9,511 visits for anoxia caused by smoke inhalation between January 1, 2016, and December 31, 2020, among adults aged 65 or older.
• Approximately 3 million older adults per year or 15 million older adults over 5 years are treated in U.S. emergency departments for falls.
• Approximately 6,046 deaths occurred from exposure to smoke, fire, and flames between January 1, 2016, and December 31, 2020, among adults aged 65 or older.
• Approximately 153,408 deaths occurred from accidental falls between January 1, 2016, and December 31, 2020, among adults aged 65 or older.
• The risk of dying from a fall increases with age. The number of deaths per year from accidental falls has increased steadily since 2016.
• Approximately 222,587 years of life are lost due to fires and accidental falls among adults aged 65 or older each year.
• In 2019, medical costs associated with fire injuries were approximately $14 million (in 2017 US dollars) for those treated and released and $199 million for those hospitalized.
• In 2017, medical costs associated with fall injuries were approximately $9 billion for those treated and released and $41 billion for those hospitalized.
• In 2019, medical costs associated with fire deaths were approximately $22 million and medical costs associated with fall deaths were approximately $939 million.
Regarding fall and fire case studies, the following can be concluded:

- Analgesics, antihypertensives, antidepressants, anticonvulsants, benzodiazepines, and statins were reported in more than one fall case study.
- Alcohol, antihypertensives, antidepressants, and opioids were reported in more than one fire death case study.

Regarding fall and fire programs and organizations, the following can be concluded:

- In the fall prevention programs reviewed, older adults are advised to review medication use with their medical provider. Specific information on medication uses or medication types and its association with fall risk is not addressed.
- In the fire prevention programs reviewed, medication use and its association with fire risk is not addressed.

It should be noted that some of the conclusions above may be time-specific in that trends in demographics, populations dynamics, and medication use may change over time.
Appendix A: Literature Review Summary Table
<table>
<thead>
<tr>
<th>Reference</th>
<th>Data Source</th>
<th>Location, Setting, Study Design</th>
<th>Study Population</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moreland 2020</td>
<td>BRFSS, 2012-2018</td>
<td>United States 2012-2018</td>
<td>Adults aged 65 years and older</td>
<td>27.5% of respondents reported falling, 10.2% reported fall related injuries; Rate of falls and fall-related injuries increased with age; Adults 85 years and older had the highest rate of falls and fall-related injuries; Higher fall rate in males, Native Americans/Alaskan Natives, and adults living in rural areas; Higher fall-related injury rate in females, Native American/Alaskan Natives, and adults living in rural areas; Increased in fall and fall-related injury rates in those with decreased self-reported health.</td>
</tr>
<tr>
<td>Burns 2018</td>
<td>CDC WONDER, 2007-2016</td>
<td>United States 2007-2016</td>
<td>Decedents aged 65 years and older</td>
<td>Increase in fall mortality rate by an average of 3.0% per year from 2006 to 2017; Higher fall mortality rates in males, Caucasians, and adults 85 years and older; Wisconsin had the highest fall mortality rate in 2017; Small metro areas had the highest rate of deaths in 2017.</td>
</tr>
<tr>
<td>Shankar 2017</td>
<td>NHMAC, 2003-2010</td>
<td>United States 2003-2010</td>
<td>Adults aged 65 years and older</td>
<td>27% increase in fall related emergency department visits from 2003 to 2010; Adults 75-84 years, Caucasians, females, and patients from the Southern U.S. had most significant increases in ED visits.</td>
</tr>
<tr>
<td>Verma 2015</td>
<td>NHIS, 2004-2013</td>
<td>United States 2004-2013</td>
<td>Adults aged 18 to 65 years and older</td>
<td>3.2 million adults age 65+ reported falling between 2004 and 2013; Adults 75+ had higher fall and fall-related injuries; Females, 65-74 years old had higher fall and fall-related injuries; Males, 75+ had higher fall rate and lower injury rate.</td>
</tr>
</tbody>
</table>
### Demographic Factors - Fires

<table>
<thead>
<tr>
<th>Source</th>
<th>Data Sources</th>
<th>Study Period</th>
<th>Description</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alamgir 2011</td>
<td>WISQARS, 2003-2007 CDC mortality and injury database, filtered by adults aged 65 years and older and fall fatalities.</td>
<td>United States 2003-2007</td>
<td>Decedents aged 65 years and older</td>
<td>43.8% of unintentional injuries were caused by falls; Adults 85 years and older, males, and Caucasians had the highest fall fatality rates; Females and Caucasians had the highest percentage change in fall mortality between 2003 and 2007; Between 2003 and 2007, New Mexico had the highest fall fatality rate followed by Vermont and Wisconsin; Lowest fall fatality rate was in Alabama.</td>
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<tr>
<td>United States Fire Administration 2019</td>
<td>NFIRS, NCHS, U.S. Census, 2009-2018</td>
<td>United States 2009-2018</td>
<td>Decedents in the U.S., including adults aged 50 and older</td>
<td>Adults 50 to 54 years old had the highest occurrence of injuries. Adults aged 85 years and older had the highest occurrence of deaths.</td>
</tr>
<tr>
<td>Ahrens 2019</td>
<td>NCHS, CDC WONDER, ACS, U.S. Census, BRFSS, 2013-2017</td>
<td>United States 2013-2017</td>
<td>Decedents in the U.S., including adults aged 55 and older</td>
<td>Death rates increased with advanced age for all races and ethnicities. In adults aged 55 and older, death rates were notably higher for African Americans/Blacks and Native Americans/Alaska Natives than for other races and ethnicities.</td>
</tr>
<tr>
<td>Ahrens 2018</td>
<td>NFIRS, NFPA FD Experience Survey, U.S. Census, 2011-2015</td>
<td>United States 2011-2015</td>
<td>Decedents in the U.S., including adults aged 45 and older</td>
<td>Adults 55-64 years old had the largest number of fire deaths. Adults aged 45 and older made up 45% of fire-related injuries and 67% of fire-related deaths.</td>
</tr>
<tr>
<td>American Burn Association 2016</td>
<td>NBR, 2005-2014</td>
<td>United States 2005-2014</td>
<td>Decedents in the U.S.</td>
<td>Men and Caucasians are more likely to suffer from burns.</td>
</tr>
<tr>
<td>Study</td>
<td>Dataset/Method</td>
<td>Population Age</td>
<td>Findings</td>
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<td>Han 2020</td>
<td>NSDUH, 2015-2018 National interview for people aged 12 and older regarding drug use and health-related issues. Data analysis restricted to adults aged 65 and older and cannabis use</td>
<td>Adults aged 65 years and older</td>
<td>Cannabis use increased from 2.4% to 4.2% from 2015 to 2018. Overall increase in males and females, all races, and those with chronic diseases and adults being treated for mental health illness. Increase in concurrent cannabis use with alcohol and tobacco use increase. Greater increases seen in males and non-Hispanic whites.</td>
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<tr>
<td>CDC National Health and Nutrition Examination Survey 2019</td>
<td>NHANES, 2015-2018 Annual national interview for nationally representative sample of around 5,000 people. Data analysis restricted to older adults and prescription medication use</td>
<td>Adults aged 45-64 and 65 years and older</td>
<td>67.1% of adults 45-64 indicated use of at least one prescription drug. 88.5% of adults 65 and older indicated use of at least one prescription drug. 36.5% of adults 45-64 indicated use of at least three or more prescription drugs. 66.4% of adults 65 and older indicated use of at least three or more prescription drugs. 18.0% of adults 45-64 indicated use of at least five or more prescription drugs. 41.9% of adults 65 and older indicated use of at least five or more prescription drugs.</td>
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<tr>
<td>Han 2019</td>
<td>NSDUH, 2015-2017 National interview for people aged 12 and older regarding drug use and health-related issues. Data analysis restricted to adults aged 65 and older and alcohol consumption</td>
<td>Adults aged 65 years and older</td>
<td>Binge drinking identified in 10.6% of participants. Men, tobacco or cannabis users, and Non-Hispanic African Americans were more likely to binge drink.</td>
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<tr>
<td>Nothelle 2019</td>
<td>Literature Review, 2006-2017 Review of literature related to potentially inappropriate medication use in adults aged 65 years and older</td>
<td>Adults aged 65 years and older</td>
<td>Women, adults taking multiple medications, and adults with increased healthcare facility visits had a higher associated with PIM use. Individuals living in the south and west had a higher association with PIM use.</td>
<td></td>
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<tr>
<td>Study</td>
<td>Design/Details</td>
<td>Study Population</td>
<td>Alcohol Consumption</td>
<td>Other Findings</td>
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<tr>
<td>CDC National Health Interview Survey 2018</td>
<td>United States 2004-2013 Cross-sectional home interview survey, adults sampled based on geographical clustering, excludes those that do not have a fixed home address. Data analysis restricted to adults 18 years and older and alcohol consumption</td>
<td>Adults 18 and older, including older adults</td>
<td>14.5% of adults 45-64 were current infrequent users and 53.5% were current regular users. 13.9% of adults 65-74 were current infrequent users and 45.0% were current regular users. 12.2% of adults 75 and older were current infrequent users and 33% were current regular users. Current regular use was highest in Asians (14.7%) and African Americans/Caucasians (19.9%).</td>
<td></td>
</tr>
<tr>
<td>Hanlon 2017</td>
<td>United States 1997-2013 Survey on medication use in well-functioning African American and Caucasian adults aged 70 to 79 years living in Pittsburgh, PA and Memphis, TN</td>
<td>3,055 African American and Caucasian adults aged 70 to 79 years</td>
<td>Over 34.0% had at least one drug interaction. 25.1% had one or more drug-drug interactions. Around 10.7% had a drug-drug interaction involving an OTC medication. NSAIDs were the most common drug class affecting other drugs, whereas cardiovascular agents were the most affected drug class. Adults with a history of falls or fractures were the second most likely group to experience drug-disease interactions, with benzodiazepines being the most common affecting drug.</td>
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<tr>
<td>Holton 2017</td>
<td>United States 1990-2016 Review of literature regarding concurrent alcohol and alcohol interactive medications. 7 literature reviews on the United States included.</td>
<td>Older adults</td>
<td>Concurrent use of alcohol and AI medications in older adults ranged from 21 to 35%. Concurrent use of alcohol and psychotropic drugs in older adults ranged from 7.4 to 7.75%.</td>
<td></td>
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<tr>
<td>Study</td>
<td>Year</td>
<td>Data Source</td>
<td>Study Design</td>
<td>Sample Size</td>
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<td>Qato 2016</td>
<td>NSHAP, 2005-2011</td>
<td>United States 2005-2006 and 2010-2011</td>
<td>Nationally representative sample of adults 57-85 in 2005-2006. For the 2010-2011 NSHAP, cohabiting partners/spouses of 2005-2006 respondents and those that chose not respond in 2005-2006 were included. Data analysis restricted to medication use.</td>
<td>3,005 adults aged 57-85 in 2005-2006, additional adults included in 2010-2011</td>
</tr>
<tr>
<td>Charlesworth 2015</td>
<td>NHANES, 1988-2010</td>
<td>United States 1998-2010</td>
<td>Annual national interview for nationally representative sample of around 5,000 people. Data analysis restricted to adults 65 and older and prescription medication use</td>
<td>Adults aged 65 years and older</td>
</tr>
<tr>
<td>Kuerbis 2014</td>
<td>Various</td>
<td>United States 2002-2012</td>
<td>Analysis of existing literature and data regarding substance abuse disorder in older adults</td>
<td>Older adults</td>
</tr>
<tr>
<td>Medication Use, Common Medications, and Available Data- Falls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lohman 2021</strong></td>
<td><strong>HRS and PDS, 2004-2006</strong></td>
<td>United States 2004-2006 Surveys on the community dwelling adults aged 65 and older. Data analysis restricted to antidepressant use and falls</td>
<td>Community dwelling adults aged 65 and older</td>
<td>Odds ratio for major depressive disorder and falls was 1.92 and for fall-related injuries was 1.67. Antidepressant medication use accounted for 19% of the association between major depressive disorder and falls and 18% of the association between major depressive disorder and fall-related injuries.</td>
</tr>
<tr>
<td><strong>Haddad 2021</strong></td>
<td><strong>MCBS, 2009-2013</strong></td>
<td>United States 2009-2013 Survey on adults 65 years and older using Medicare. Data analysis restricted to psychoactive medications, specifically antidepressants and falls</td>
<td>Community dwelling adults aged 65 and older</td>
<td>Opioids were the most commonly reported drug class being used (31.1%), followed by SSRIs (13.1%) and benzodiazepines (10.6%). The highest percentage of falls was reported by adults using SNRIs (42%). Adults taking SSRIs or SNRIs saw the risk of falling increase by 30%.</td>
</tr>
<tr>
<td><strong>Yoshikawa 2020</strong></td>
<td><strong>Literature Review, onset to 2019</strong></td>
<td>Inception of searched databases-2019 Review of literature regarding the relationship between opioid use and falls in older adults</td>
<td>Adults aged 65 years and older</td>
<td>There is a relationship between opioid use and falls, fall injuries, and fractures. There is a greater association between opioid use and fracture risk when compared to risk of falls and fall injuries.</td>
</tr>
<tr>
<td><strong>Beers Criteria 2019</strong></td>
<td><strong>Beers Criteria, 2019</strong></td>
<td>United States 2019 Criteria for identifying potentially inappropriate medications for older adults, including those associated with falls</td>
<td>Older adults (criteria sources from source of adults, primarily 65 years and older)</td>
<td>SNRIs were added to the list of drugs to avoid in individuals with a history of falls and fractures. Antipsychotics, benzodiazepines and nonbenzodiazepines (e.g., insomnia drugs or z-drugs) cause an increased risk of cognitive impairment, falls, and fractures. Older adults with fall and fracture history should avoid antiepileptics, antipsychotics, benzodiazepines, nonbenzodiazepines, antidepressants, and opioids. Older adults taking three or more drugs classified as antidepressants, antipsychotics, antiepileptics, benzodiazepines, nonbenzodiazepines, and opioids have an increased fall risk.</td>
</tr>
<tr>
<td>Reference</td>
<td>Year, Type</td>
<td>Date Range</td>
<td>Sample Description</td>
<td>Findings</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------</td>
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<td>--------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Holton 2019</td>
<td>TILDA, 2009-2015</td>
<td>Ireland 2009-2015</td>
<td>1457 adults aged 65 years and older</td>
<td>64% of adults reported alcohol consumption at their first interview. 7% were at risk for one serious fall due to drug-alcohol interaction, and 5% were at risk for two or more falls due to drug-alcohol interactions in the initial interview. Heavy alcohol consumption with central nervous system agents increased fall and fall injury risk. Concurrent use of alcohol and CNS drugs resulted in an absolute fall risk of 19% and absolute injurious fall risk of 8%.</td>
</tr>
<tr>
<td>Laberge 2019</td>
<td>Literature Review, inception-2018</td>
<td>1988-2018 Review of literature regarding fall risk increase for older adults through psychotropic medication alone and in combination with alcohol</td>
<td>Adults aged 60 and older</td>
<td>Fall risk was associated with use of benzodiazepines and antidepressants, especially SSRIs. No fall risk was not associated with alcohol, antiepileptics, antipsychotics, and antihypertensives.</td>
</tr>
<tr>
<td>Ang 2018</td>
<td>Literature Review, inception-2017</td>
<td>Inception of searched databases-2017 Review of literature regarding the relationship between antihypertensives and fall risk</td>
<td>Adults aged 60 and older</td>
<td>No association between falls and recurrent falls and ACEi, BB, and CCB medication use. No fall outcomes linked to AB, ARB, and diuretic use.</td>
</tr>
<tr>
<td>Kahlaee 2018</td>
<td>Literature Review, 2007-2017</td>
<td>2007-2017 Review of literature regarding the relationship between antihypertensives and fall risk</td>
<td>Adults aged 60 and older</td>
<td>Fall risk is dependent upon the duration of medication use. The risk of falling increased up to 36 times during the first 24 hours of medication initiation, change, or dose increase. No significant relationship between chronic antihypertensive medication use and fall risk</td>
</tr>
<tr>
<td>Díaz-Gutiérrez 2017</td>
<td>Literature Review, 2007-2017</td>
<td>2007-2017 Review of literature regarding the relationship between benzodiazepines and fall risk</td>
<td>Adults aged 65 years and older</td>
<td>Benzodiazepine use, by itself and in combination with other drugs, increased fall risk.</td>
</tr>
<tr>
<td>Study</td>
<td>Study Details</td>
<td>Participants</td>
<td>Findings</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------</td>
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<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Musich 2017</td>
<td>AARP Medicare Supplement, AARP Medicare Part D Rx plans, 2015</td>
<td>United States 2015</td>
<td>44% adults were using a minimum of one fall related drug. Women, adults aged 70-79 years old, Caucasians, and adults from Southern states were more likely to use fall related drugs. New and continuing users commonly used benzodiazepines, anticonvulsants, SSRIs, and non-benzodiazepine hypnotics. Previous fall history and polypharmacy are risk factors for falling.</td>
<td></td>
</tr>
<tr>
<td>Chen 2017</td>
<td>HRS, 2006-2014 Baseline survey and two year follow ups on community-dwelling older adults. Data analysis restricted to the relationship between insomnia symptoms, sleep medications, and fall risk</td>
<td>Adults aged 65 years and older</td>
<td>The likelihood of falling was 28% with no insomnia symptoms and increased to 40% with 4 symptoms. Adults using sleep medication reported more falls than non-users, with prescription medications having a greater effect than OTC medications. Number of insomnia symptoms and taking physician-recommended sleep medications independently increases future fall risk.</td>
<td></td>
</tr>
<tr>
<td>Watanabe 2016</td>
<td>NHATS, 2011 Survey for a nationally representative sample of adults using Medicare. Data analysis restricted to the relationship between medication use and falls</td>
<td>Adults aged 65 years and older</td>
<td>10.29% of adults using medication had fallen in the last month and 22.82% had fallen in the last year compared to 5.42% and 13.15% of non-users, respectively</td>
<td></td>
</tr>
<tr>
<td>de Jong 2013</td>
<td>Literature Review, Unknown-2013 Review of literature regarding drug related falls in older adults and prevention strategies</td>
<td>Older adults (generally 55 years and older)</td>
<td>Antidepressants, neuroleptics and antipsychotics, benzodiazepines, sedatives and hypnotics, antihypertensive agents, nonsteroidal anti-inflammatory drugs (NSAID), diuretics, β blockers, and narcotics are identified as fall risk increasing drugs.</td>
<td></td>
</tr>
</tbody>
</table>

**Medication Use, Common Medications, and Available Data - Fires**

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Details</th>
<th>Participants</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dinaburg 2020</td>
<td>Literature Review, unreported date range Review of literature regarding waking to audible fire alarms</td>
<td>NA</td>
<td>Those intoxicated or on drugs are part of a susceptible population that does not “fully benefit” from traditional smoke alarm technology</td>
</tr>
<tr>
<td>Reference</td>
<td>Dataset/Study Details</td>
<td>Findings</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------</td>
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</tr>
<tr>
<td>Doyle 2019</td>
<td>Ireland 2014-2016 National database of drug related deaths, filtered by fire deaths.</td>
<td>106 decedents, 52% were 65 years and older</td>
<td>For fatalities involving individuals 60 years and older, 76% had alcohol and/or drugs in their system. Of these, 36% tested positive for alcohol only, 33% tested positive for drugs only, and 31% had both alcohol and drugs in their systems. For all fatalities that were positive for drugs, two-thirds had more than one drug in their system. The most frequently found drugs were antidepressants, benzodiazepines, non-opioid analgesics, hypnotics, and opioids.</td>
</tr>
<tr>
<td>Harpur 2014</td>
<td>Northern Ireland 1999-2009 Study on factors contributing to fire deaths, including adults aged 60 years and older</td>
<td>141 decedents total, 65 adults aged 60 years and older</td>
<td>Older adults and men had more fatalities. 73.8% of older adult fatalities were smokers and 63.6% were problem drinkers. 50% of older adults tested positive for alcohol. Of the 11 adults tested for drugs, 45.5% tested positive. Detected drugs included pain relievers and benzodiazepines.</td>
</tr>
<tr>
<td>Lykiardopoulos 2014</td>
<td>Australia 1998-2007 Study One- investigating impact of psychotropic drugs on waking to audible alarms of two different frequencies</td>
<td>Study One-12 adults aged 65-80 years using hypnotic or sedative drugs two to six nights a week. Study Two-164 decedents over the age of 18</td>
<td>Study One- Hypnotic drugs raised the auditory threshold by 9 dBA for both waves. At 75 dBA, the 520 Hz square wave woke users up every time, whereas two people failed to awaken with the 3100 Hz sine wave. With no drugs, only one participant failed to awake when exposed to the 3100 Hz sine wave. Study Two- Of the 164 fire deaths, 108 were tested for drugs. An average of 1.5 psychotropic drugs were found in those that tested positive. Hypnotic/sedative drugs were found in 29% of those tested and antidepressants were found in 10%. For persons taking hypnotics, adults aged 30-60 were more at risk for fire fatalities than adults 60 and older.</td>
</tr>
<tr>
<td>Reference</td>
<td>Type</td>
<td>Location</td>
<td>Study Description</td>
</tr>
<tr>
<td>-----------</td>
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<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Bruck 2007</td>
<td>Human Subject</td>
<td>Australia</td>
<td>Study investigating effects of alcohol on fire alarm waking</td>
</tr>
<tr>
<td>Ball 2004</td>
<td>Human Subject</td>
<td>Australia</td>
<td>Study investigating effects of alcohol on fire alarm waking</td>
</tr>
<tr>
<td>Bruck 2001</td>
<td>Various, unreported date range</td>
<td>Australia</td>
<td>Review of literature regarding factors affecting sleep arousal</td>
</tr>
<tr>
<td>Marshall 1998</td>
<td>Coronial Reports, 1988-1989</td>
<td>United States 1988-1989</td>
<td>Data analysis on fire death trends in North Carolina</td>
</tr>
<tr>
<td>Grace 1997</td>
<td>Various, unreported date range</td>
<td>New Zealand</td>
<td>Literature review and study on sleep characteristics and the effect of drugs on sleep</td>
</tr>
</tbody>
</table>
## Appendix B: Fall Prevention Programs Summary Table

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Organization</th>
<th>Target Audience</th>
<th>Objectives</th>
<th>Methods</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| Falls Prevention for Older Adults | National Council of Aging (NCOA)                | Adults aged 55+, caregivers, healthcare providers | Aid all older adults in aging well by providing resources, tool kits, and assistance to professionals and older adults, and advocating to strengthen federal programs that aid in aging | – Online articles, lists of fall prevention programs, and fall prevention stories  
– Fall risk questionnaire  
– Age Well tool  
– NCOA hosts a Falls Prevention Awareness Week | – Home safety, proper exercise, and routine health checkups  
– Maintain medication forms  
– Fire department involvement  
– Caregiver involvement  
– Promotion of fall prevention by healthcare professionals in communities  
– Use of community programs |
| MyMobility Plan                   | Centers for Disease Control and Prevention (CDC) | Adults aged 65+                       | Aid older adults in remaining independently mobile as they age | – Online tool with 3 components  
○ Myself- focused on health management tips  
○ MyHome- addresses fall prevention via home safety  
○ MyNeighborhood- develops a plan for travel within one’s own neighborhood | – Review medication regimens  
– Annual physical and eye exam  
– Exercise regularly and perform strength and balance exercises at least three times a week  
– Home safety  
– Transportation plans and use of rideshare services |
| Older Adult Fall Prevention | Centers for Disease Control and Prevention (CDC) | Adults aged 65+, caregivers, healthcare providers | Educate older adults on how to prevent falls and fall-related injuries as they age | Online information on falls and injuries and fall-related deaths
Tips to maintain health and reduce fall risk
Educational resources and publications
CDC Compendium of Effective Fall Interventions
Community-oriented guide on how to implement community-based fall programs. | Doctors should evaluate fall risk, review medications, and perform eye exams
Vitamin D supplements
Strength and balance exercises
Home safety
Healthcare providers to learn how to identify and modify fall risks through home safety, improving strength and vision, reducing risky behaviors, and providing psychological support
Plan for and select an appropriate community fall program |

| STEADI- Stopping Elderly Accidents, Deaths, and Injuries (CDC) | Centers for Disease Control and Prevention (CDC) | Community dwelling adults aged 65+ and healthcare providers | Identify patient fall risk, modifiable fall risk factors, and provide interventions to reduce fall risk | Online information on reducing fall risk and eliminating hazards
Online continuing education for healthcare providers and training for pharmacists
Algorithms and video examples on how to conduct a fall risk assessment
Integrating STEADI with electronic health records | Initial multifactorial fall risk assessment and yearly reassessments
After being assessed, patients should be provided with information on home safety and local exercise and fall prevention programs
Healthcare providers conduct a follow-up within 30 to 90 days. |
<table>
<thead>
<tr>
<th>Program</th>
<th>Organization</th>
<th>Target Group</th>
<th>Description</th>
<th>Activities Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fit &amp; Strong</strong></td>
<td>Midwest Roybal Center</td>
<td>Older adults with arthritis and caregivers</td>
<td>Help people with osteoarthritis learn how to exercise properly and gain a better understanding of how physical exercise can help manage arthritis symptoms. Maintain independent functioning for older adults with osteoarthritis</td>
<td>In-person exercise sessions, Assists participants in developing and implementing plans for physical activity and management of arthritis, Certification program for trainers</td>
</tr>
<tr>
<td><strong>A Matter of Balance</strong></td>
<td>Roybal Center at Boston University</td>
<td>Community dwelling adults aged 60+ and caregivers</td>
<td>Learn that the fear of falling is controllable. Set goals to increase activity and reduce controllable fall risk factors at home. Learn exercises that increase balance and strength and continue to practice them after the program ends</td>
<td>In-person education and exercise sessions, Online education and guided exercise sessions, Training for coaches and trainers.</td>
</tr>
<tr>
<td><strong>Enhance Fitness</strong></td>
<td>Project Enhance</td>
<td>Older adults and caregivers</td>
<td>Promote a physically active lifestyle in older adults to provide social interaction, reduce falls and fall risk factors, and empower an independent lifestyle</td>
<td>In-person exercise sessions, Training for instructors, Web-based data collection</td>
</tr>
</tbody>
</table>

- Exercise to build balance and strength
- Understand fall risk factors
- Develop an action plan to address fall risk factors, continue exercising, and control fears of falling
- Maintain proper posture
- Home modifications

- Exercise to build strength, balance, and flexibility
- Eat cleanly
- Build a support group
Appendix C: CDC STEADI Stay Independent Brochure Checklist

### Check Your Risk for Falling

<table>
<thead>
<tr>
<th>Circle “Yes” or “No” for each statement below</th>
<th>Why it matters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (2)</td>
<td>No (0)</td>
</tr>
<tr>
<td>Yes (2)</td>
<td>No (0)</td>
</tr>
<tr>
<td>Yes (1)</td>
<td>No (0)</td>
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<tr>
<td>Yes (1)</td>
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<td>Yes (1)</td>
<td>No (0)</td>
</tr>
<tr>
<td>Yes (1)</td>
<td>No (0)</td>
</tr>
</tbody>
</table>

**Total**

Add up the number of points for each “yes” answer. If you scored 4 points or more, you may be at risk for falling.

This checklist was developed by the Greater Los Angeles VA Geriatric Research Education Clinical Center and affiliates and is a validated fall risk self-assessment tool (Rubenstein et al. J Safety Res; 2011; 42(6):493-499). Adapted with permission of the authors.
# Appendix D: Fire Prevention Programs Summary Table

<table>
<thead>
<tr>
<th>Program Name</th>
<th>Organization</th>
<th>Target Audience</th>
<th>Objectives</th>
<th>Methods</th>
<th>Recommendations</th>
</tr>
</thead>
</table>
| **Fire is Everyone’s Fight (FIEF)**       | U.S. Fire Administration (USFA)     | Fire departments, life safety organizations, and fire and life safety professionals. | To unite the fire service, life safety organizations and professionals to reduce home fire injuries, deaths and property loss by changing how people think about fire and fire prevention. | – Provides outreach materials for distribution and public education  
– A logo is made available for use by fire departments and agencies | – Develop and practice a home escape plan  
– Install, and maintain smoke alarms  
– Control ignition sources around medical oxygen  
– Take special precautions with smoking, cooking, and heating  
– Caregivers involvement |
| **Fire Safe Seniors Program**              | Centers for Disease Control and Prevention (CDC) and the U.S. Fire Service Administration (USFA) | Organizations that serve seniors at the national, state or community level | To help organizations plan and implement fire safety interventions for the high-risk group of older adults | – Provides resources such as an implementation guide, training curricula for staff, home assessment tools, and educational handouts | – Home assessments  
– Smoke detector installation  
– In-person education sessions  
– Follow ups |
| **Home Fire Safety for Older Adults**     | Electrical Safety Foundation International (ESFI) | Older adults and their families | To provide tools to educate older adults and their families nationwide about home fire hazards related to cooking, heating, and electrical equipment. | – Provides educational resources such as public service announcements, community outreach presentations, and fire safety tips documents. | – Learn about potential fire hazards, specifically associated with cooking, heating, and electrical equipment  
– Family and caregiver involvement  
– Family fire escape plan, updated regularly |
<table>
<thead>
<tr>
<th>Program Name</th>
<th>Location/Agency</th>
<th>Target Population</th>
<th>Benefits</th>
<th>Services/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Safe Home</td>
<td>Scottsdale, AZ Fire Department</td>
<td>Seniors and individuals living with disabilities</td>
<td>Free home evaluations, covering both fire safety and fall prevention in the home</td>
<td>EDITH (Exit Drills in the Home) Adamπt windows and doors are available for safe egress Learning to shelter-in-place</td>
</tr>
<tr>
<td>Senior Home Inspection Program (Project SHIP)</td>
<td>Huntington Beach, CA Fire Department</td>
<td>Residents aged 60+</td>
<td>Free home fire safety inspections Install free smoke detectors</td>
<td>Home fire safety inspections Combo detector/carbon monoxide detectors installed</td>
</tr>
<tr>
<td>Senior Outreach Program</td>
<td>Montgomery County, MD Fire and Rescue Service (MCFRS)</td>
<td>Seniors and individuals living with disabilities</td>
<td>Online educational resources and community outreach services Free home safety checks and smoke alarm installations</td>
<td>Checking smoke detectors Developing fire escape plans and performing drills Practicing safe smoking. Family and caregiver involvement</td>
</tr>
<tr>
<td>Senior SAFE Program</td>
<td>Massachusetts Department of Fire Services</td>
<td>Massachusetts fire departments and agencies that serve seniors</td>
<td>Provides grants to local fire departments to teach fire and life safety to seniors in their communities and creates partnerships between these fire departments and agencies that serve seniors.</td>
<td>Education is key to improving the safety of seniors at home Smoke and carbon monoxide alarm installation, testing, and replacing batteries Installation of house numbers Use of heating limiting devices on stoves Installation of in-hood stove fire extinguishers Use of nightlights.</td>
</tr>
</tbody>
</table>
Appendix E: Official CMS Specifications for Quality Indicators
(CMS, 2021)
Quality ID #154 (NQF 0101): Falls: Risk Assessment
– National Quality Strategy Domain: Patient Safety
– Meaningful Measure Area: Preventable Healthcare Harm

2021 COLLECTION TYPE:
MEDICARE PART B CLAIMS

MEASURE TYPE:
Process – High Priority

This is a two-part measure which is paired with Measure #155: Falls: Plan of Care. If the falls risk assessment indicates the patient has documentation of two or more falls in the past year or any fall with injury in the past year (CPT II code 1100F is submitted), #155 may also be submitted.

DESCRIPTION:
Percentage of patients aged 65 years and older with a history of falls that had a risk assessment for falls completed within 12 months

INSTRUCTIONS:
This measure is to be submitted a minimum of once per performance period for patients seen during the performance period. There is no diagnosis associated with this measure. This measure is appropriate for use in all non-acute settings (with the exception of emergency departments and acute care hospitals). This measure may be submitted by Merit-based Incentive Payment System (MIPS) eligible clinicians who perform the quality actions described in the measure based on the services provided and the measure-specific denominator coding.

NOTE: Patient encounters for this measure conducted via telehealth (e.g., encounters coded with GQ, GT, 95, or POS 02 modifiers) are allowable.

Measure Submission Type:
Measure data may be submitted by individual MIPS eligible clinicians using Medicare Part B claims. The listed denominator criteria are used to identify the intended patient population. The numerator quality data codes included in this specification are used to submit the quality actions allowed by the measure on the claim form(s). All measure-specific coding should be submitted on the claim(s) representing the denominator eligible encounter and selected numerator option.

DENOMINATOR:
All patients aged 65 years and older who have a history of falls (history of falls is defined as 2 or more falls in the past year or any fall with injury in the past year). Documentation of patient reported history of falls is sufficient

Denominator Criteria (Eligible Cases):
Patients aged ≥ 65 years on date of encounter
AND
Patient encounter during the performance period (CPT or HCPCS): 92540, 92541, 92542, 92543, 97161, 97162, 97163, 97164, 97165, 97166, 97167, 97168, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99304, 99305, 99306, 99307, 99308, 99309, 99310, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337, 99341, 99342, 99343, 99344, 99345, 99346, 99349, 99350, G0402, G0438, G0439

NUMERATOR:
Patients who had a risk assessment for falls completed within 12 months

Definitions:
Fall – A sudden, unintentional change in position causing an individual to land at a lower level, on an object,
the floor, or the ground, other than as a consequence of sudden onset of paralysis, epileptic seizure, or overwhelming external force.

**Risk Assessment** — Comprised of balance/gait AND one or more of the following: postural blood pressure, vision, home fall hazards, and documentation on whether medications are a contributing factor or not to falls within the past 12 months.

**Balance/gait Assessment** - Medical record must include documentation of observed transfer and walking or use of a standardized scale (e.g., Get Up & Go, Berg, Tinetti) or documentation of referral for assessment of balance/gait.

**Postural blood pressure** - Documentation of blood pressure values in supine and then standing positions.

**Vision Assessment** - Medical record must include documentation that patient is functioning well with vision or not functioning well with vision based on discussion with the patient or use of a standardized scale or assessment tool (e.g., Snellen) or documentation of referral for assessment of vision.

**Home fall hazards Assessment** - Medical record must include documentation of counseling on home falls hazards or documentation of inquiry of home fall hazards or referral for evaluation of home fall hazards.

**Medications Assessment** - Medical record must include documentation of whether the patient’s current medications may or may not contribute to falls.

**Numerator Instructions:**
All components do not need to be completed during one patient visit, but should be documented in the medical record as having been performed within the past 12 months.

**NUMERATOR NOTE:** The correct combination of numerator code(s) must be submitted on the claim form in order to properly submit this measure. The “correct combination” of codes may require the submission of multiple numerator codes.

**Numerator Quality-Data Coding Options:**
**Patient receiving Hospice Services, Patient Not Eligible:**
(One code [G9718] is required on the claim form to submit this numerator option)

**Denominator Exclusion:** G9718: Hospice services for patient provided any time during the measurement period

**OR**
If patient is not eligible for this measure because patient has documentation of no falls or only one fall without injury the past year, submit: Patient not at Risk for Falls
(One CPT II code [1101F] is required on the claim form to submit this numerator option)

**Denominator Exclusion:** CPT II 1101F: Patient screened for future fall risk; documentation of no falls in the past year or only one fall without injury in the past year

**OR**
If patient is not eligible for this measure because falls status is not documented, submit: Falls Status not Documented
(One CPT II code [1101F-8P] is required on the claim form to submit this numerator option)
Append a submission modifier (8P) to CPT Category II code 1101F to submit circumstances when the patient is not eligible for the measure.

**Denominator Exclusion:** 1101F with 8P: No documentation of falls status

**OR**
Risk Assessment for Falls Completed
(Two CPT II codes [3288F & 1100F] are required on the claim form to submit this numerator option)

**Performance Met:** CPT II 3288F: Falls risk assessment documented

AND

CPT II 1100F: Patient screened for future fall risk; documentation of two or more falls in the past year or any fall with injury in the past year

--- Page 70 ---
OR

Risk Assessment for Falls not Completed for Medical Reasons
(Two CPT II codes [3288F-1P & 1100F] are required on the claim form to submit this numerator option)

Denominator Exception: 3288F with 1P: Documentation of medical reason(s) for not completing a risk assessment for falls (i.e., patient is not ambulatory, bed ridden, immobile, confined to chair, wheelchair bound, dependent on helper pushing wheelchair, independent in wheelchair or minimal help in wheelchair)

AND

CPT II 1100F: Patient screened for future fall risk; documentation of two or more falls in the past year or any fall with injury in the past year

OR

Risk Assessment for Falls not Completed, Reason not Otherwise Specified
(Two CPT II codes [3288F-8P & 1100F] are required on the claim form to submit this numerator option)

Append a submission modifier (8P) to CPT Category II code 3288F to submit circumstances when the action described in the numerator is not performed and the reason is not otherwise specified.

Performance Not Met: 3288F with 8P: Falls risk assessment not completed, reason not otherwise specified

AND

CPT II 1100F: Patient screened for future fall risk; documentation of two or more falls in the past year or any fall with injury in the past year

Rationale:
Screening for specific medical conditions may direct the therapy. Although the clinical guidelines and supporting evidence calls for an evaluation of many factors, it was felt that for purposes of measuring performance and facilitating implementation this initial measure must be limited in scope. For this reason, the work group defined an evaluation of balance and gait as a core component that must be completed on all patients with a history of falls as well as four additional evaluations – at least one of which must be completed within the 12 month period. Data elements required for the measure can be captured and the measure is actionable by the physician.

Clinical Recommendation Statements:
Older people who present for medical attention because of a fall, or report recurrent falls in the past year, or demonstrate abnormalities of gait and/or balance should be offered a multifactorial falls risk assessment. This assessment should be performed by a healthcare professional with appropriate skills and experience, normally in the setting of a specialist falls service. This assessment should be part of an individualized, multifactorial intervention. (NICE) (Grade C)

Multifactorial assessment may include the following:

- Identification of falls history
- Assessment of gait, balance and mobility, and muscle weakness
- Assessment of osteoporosis risk
- Assessment of the older person’s perceived functional ability and fear relating to falling
- Assessment of visual impairment
- Assessment of cognitive impairment and neurological examination
- Assessment of urinary incontinence
- Assessment of home hazards
- Cardiovascular examination and medication review (nice) (grade c)
A falls risk assessment should be performed for older persons who present for medical attention because of a fall, report recurrent falls in the past year, report difficulties in walking or balance or fear of falling, or demonstrate unsteadiness or difficulty performing a gait and balance test.

The falls risk evaluation should be performed by a clinician with appropriate skills and experience.

[C] A falls risk assessment is a clinical evaluation that should include the following, but are not limited to:

- A history of fall circumstances
- Review of all medications and doses
- Evaluation of gait and balance, mobility levels and lower extremity joint function
- Examination of vision
- Examination of neurological function, muscle strength, proprioception, reflexes, and tests of cortical, extrapyramidal, and cerebellar function
- Cognitive evaluation
- Screening for depression
- Assessment of postural blood pressure
- Assessment of heart rate and rhythm
- Assessment of heart rate and rhythm, and blood pressure responses to carotid sinus stimulation if appropriate
- Assessment of home environment

The falls risks assessment should be followed by direct intervention on the identified risk. [A] (AGS)

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2021 Medicare Part B Claims Flow for Quality ID #154 (NQF 0101): Falls: Risk Assessment

Disclaimer: Refer to the measure specification for specific coding and instructions to submit this measure.
### Sample Calculations

**Data Completeness:**

<table>
<thead>
<tr>
<th>Formula</th>
<th>Numerator</th>
<th>Denominator</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Met (n=50 pts) + Denominator Exception (b=10 pts) + Performance Not Met (c=20 pts)</td>
<td>70 patients</td>
<td>=</td>
<td>87.59%</td>
</tr>
</tbody>
</table>

**Performance Rates:**

<table>
<thead>
<tr>
<th>Formula</th>
<th>Numerator</th>
<th>Denominator</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Met (n=50 pts)</td>
<td>30 patients</td>
<td>=</td>
<td>60.00%</td>
</tr>
</tbody>
</table>

*See the posted measure specification for specific coding and instructions to submit this measure.

**NOTE:** Submission Frequency: Patient-Process

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2021 Medicare Part B Claims Flow Narrative for Quality ID#154 (NQF 0101):
Falls: Risk Assessment

Disclaimer: Refer to the measure specification for specific coding and instructions to submit this measure.

1. Start with Denominator

2. Check Patient aged greater than or equal to 65 years on date of encounter:
   a. If Patient aged greater than or equal to 65 years on date of encounter equals No, do not include in Eligible Population/Denominator. Stop processing.
   b. If Patient aged greater than or equal to 65 years on date of encounter equals Yes, proceed to Patient encounter during the performance period as listed in Denominator*.

3. Check Patient encounter during the performance period as listed in Denominator*:
   a. If Patient encounter during the performance period as listed in Denominator* equals No, do not include in Eligible Population/Denominator. Stop processing.
   b. If Patient encounter during the performance period as listed in Denominator* equals Yes, include in Eligible Population/Denominator.

4. Denominator Population:
   • Denominator Population is all Eligible Patients in the Denominator. Denominator is represented as Denominator in the Sample Calculation listed at the end of this document. Letter \( d \) equals 80 patients in the Sample Calculation.

5. Start Numerator

6. Check Hospice services for patient provided any time during the measurement period:
   a. If Hospice services for patient provided any time during the measurement period equals Yes, include in Data Completeness Met and Denominator Exclusion.
      • Data Completeness Met and Denominator Exclusion is represented as Data Completeness and Performance Rate in the Sample Calculation listed at the end of this document. Letter \( y \) equals 0 patients in Sample Calculation.
   b. If Hospice services for patient provided any time during the measurement period equals No, proceed to Patient screened for future fall risk; documentation of no falls in the past year or only one fall with injury in the past year.

7. Check Patient screened for future fall risk; documentation of no falls in the past year or only one fall with injury in the past year:
   a. If Patient screened for future fall risk; documentation of no falls in the past year or only one fall with injury in the past year equals Yes, include in Data Completeness Met and Denominator Exclusion.
      • Data Completeness Met and Denominator Exclusion is represented as Data Completeness and Performance Rate in the Sample Calculation listed at the end of this document. Letter \( x \) equals 0 patients in Sample Calculation.
   b. If Patient screened for future fall risk; documentation of no falls in the past year or only one fall with injury in the past year equals No, proceed to No documentation of fall status.
8. Check No documentation of fall status:
   a. If No documentation of fall status equals Yes, include in Data Completeness Met and Denominator Exclusion.
      • Data Completeness Met and Denominator Exclusion is represented in the Data Completeness and Performance Rate in the Sample Calculation listed at the end of this document. Letter \( x^2 \) equals 10 patients in the Sample Calculation.
   b. If No documentation of fall status equals No, proceed to Falls risk assessment documented AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year.

9. Check Falls risk assessment documented AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year:
   a. If Falls risk assessment documented AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year equals Yes, include in Data Completeness Met and Performance Met.
      • DataCompleteness Met and Performance Met is represented as Data Completeness and Performance Rate in the Sample Calculation listed at the end of this document. Letter \( a \) equals 30 patients in the Sample Calculation.
   b. If Falls risk assessment documented AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year equals No, proceed to Documentation of medical reason(s) for not completing a risk assessment for falls AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year.

10. Check Documentation of medical reason(s) for not completing a risk assessment for falls AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year:
    a. If Documentation of medical reason(s) for not completing a risk assessment for falls AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year equals Yes, include in Data Completeness Met and Denominator Exception.
       • Data Completeness Met and Denominator Exception is represented as Data Completeness and Performance Rate in the Sample Calculation listed at the end of this document. Letter \( b \) equals 10 patients in Sample Calculation.
    b. If Documentation of medical reason(s) for not completing a risk assessment for falls AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year equals No, proceed to Falls risk assessment not completed, reason not otherwise specified AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year.

11. Check Falls risk assessment not completed, reason not otherwise specified AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year:
    a. If Falls risk assessment not completed, reason not otherwise specified AND patient screened for future fall risk; documentation of 2 or more falls in the past year or any fall with injury in the past year equals Yes, include in the Data Completeness Met and Performance Not Met.
       • Data Completeness Met and Performance Not Met is represented as Data Completeness in
the Sample Calculation listed at the end of this document. Letter c equals 20 patients in the Sample Calculation.

b. If Falls risk assessment not completed, reason not otherwise specified AND patient screened for future fall risk, documentation of 2 or more falls in the past year or any fall with injury in the past year equals No, proceed to Data Completeness Not Met.

12. Check Data Completeness Not Met.

a. If Data Completeness Not Met, the Quality Data Code was not submitted. 10 patients have been subtracted from the Data Completeness Numerator in the Sample Calculation.

Sample Calculations:

Data Completeness equals Denominator Exclusion (x¹ plus x² plus x³ equals 10 patients) plus Performance Met (a equals 30 patients) plus Denominator Exception (b equals 10 patients) plus Performance Not Met (c equals 20 patients) divided by Eligible Population / Denominator (d equals 80 patients). All equals 70 patients divided by 80 patients. All equals 87.5 percent.

Performance Rate equals Performance Met (a equals 30 patients) divided by Data Completeness Numerator (70 patients) minus Denominator Exclusion (x¹ plus x² plus x³ equals 10 patients) minus Denominator Exception (b equals 10 patients). All equals 30 patients divided by 50 patients. All equals 30 patients divided over 50 patients. All equals 60.00 percent.

*See the posted measure specification for specific coding and instructions to submit this measure.

NOTE: Submission Frequency: Per patient

The measure diagrams were developed by CMS as a supplemental resource to be used in conjunction with the measure specifications. They should not be used alone or as a substitution for the measure specification.
Quality ID #155 (NQF 0101): Falls: Plan of Care
- National Quality Strategy Domain: Communication and Care Coordination
- Meaningful Measure Area: Preventable Healthcare Harm

2021 COLLECTION TYPE:
MEDICARE PART B CLAIMS

MEASURE TYPE:
Process – High Priority

This is a two-part measure which is paired with Measure #154: Falls: Risk Assessment.

This measure may be submitted if CPT II code 1100F “Patient screened for future falls risk; documentation of two or more falls in the past year or any fall with injury in the past year” is submitted for Measure #154.

DESCRIPTION:
Percentage of patients aged 65 years and older with a history of falls that had a plan of care for falls documented within 12 months

INSTRUCTIONS:
This measure is to be submitted a minimum of once per performance period for patients seen during the performance period. There is no diagnosis associated with this measure. This measure is appropriate for use in all non-acute settings (with the exception of emergency departments and acute care hospitals). This measure may be submitted by Merit-based Incentive Payment System (MIPS) eligible clinicians who perform the quality actions described in the measure based on the services provided and the measure-specific denominator coding.

NOTE: Patient encounters for this measure conducted via telehealth (e.g., encounters coded with G0, GT, 95, or POS 02 modifiers) are allowable.

Measure Submission Type:
Measure data may be submitted by individual MIPS eligible clinicians using Medicare Part B claims. The listed denominator criteria are used to identify the intended patient population. The numerator quality data codes included in this specification are used to submit the quality actions allowed by the measure on the claim form(s). All measure-specific coding should be submitted on the claim(s) representing the denominator eligible encounter and selected numerator option.

DENOMINATOR:
All patients aged 65 years and older with a history of falls (history of falls is defined as 2 or more falls in the past year or any fall with injury in the past year). Documentation of patient reported history of falls is sufficient

Denominator Criteria (Eligible Cases):
Patients aged ≥ 65 years on date of encounter

AND

All eligible instances when CPT II code 1100F (Patient screened for future fall risk, documentation of two or more falls in the past year or any fall with injury in the past year) is submitted in the numerator for Measure #154

AND

Patient encounter during the performance period (CPT or HCPCS): 92540, 92541, 92542, 92548, 97161, 97162, 97163, 97164, 97165, 97166, 97167, 97168, 99202, 99203, 99204, 99205, 99211, 99212, 99213, 99214, 99215, 99304, 99305, 99306, 99307, 99308, 99309, 99310, 99324, 99325, 99326, 99327, 99328, 99334, 99335, 99336, 99337, 99341, 99342, 99343, 99344, 99345, 99347, 99348, 99349, 99350, G0402, G0438, G0439

Version 5.0
November 2020

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NUMERATOR:
Patients with a plan of care for falls documented within 12 months

Definitions:
Plan of Care – Must include: balance, strength, and gait training.
Balance, Strength, and Gait Training – Medical record must include: documentation that balance, strength, and gait training/instructions were provided OR referral to an exercise program, which includes at least one of the three components: balance, strength or gait OR referral to physical therapy.
Fall – A sudden, unintentional change in position causing an individual to land at a lower level, on an object, the floor, or the ground, other than as a consequence of sudden onset of paralysis, epileptic seizure, or overwhelming external force.

Numerator Instructions:
All components do not need to be completed during one patient visit, but should be documented in the medical record as having been performed within the past 12 months.

Numerator Quality-Data Coding Options:
Patient receiving Hospice Services, Patient Not Eligible:
Denominator Exclusion: G9720:
Hospice services for patient occurred any time during the measurement period

OR

Plan of Care Documented
Performance Met: CPT II 0518F:
Falls plan of care documented

OR

Risk Assessment for Falls not Completed for Medical Reasons
Denominator Exception: 0518F with 1P
Patient not ambulatory, bed ridden, immobile, confined to chair, wheelchair bound, dependent on helper pushing wheelchair, independent in wheelchair or minimal help in wheelchair

OR

Plan of Care not Documented, Reason not Otherwise Specified
Append a submission modifier (8P) to CPT Category II code 0518F to submit circumstances when the action described in the numerator is not performed and the reason is not otherwise specified.
Performance Not Met: 0518F with 8P:
Falls plan of care not documented, reason not otherwise specified

RATIONALE:
Interventions to prevent future falls should be documented for the patient with 2 or more falls or injurious falls.

CLINICAL RECOMMENDATION STATEMENTS:
The USPSTF recommends exercise or physical therapy to prevent falls in community-dwelling adults aged 65 years or older who are at increased risk for falls.
Grade: B Recommendation.
The AGS 2010 Clinical Practice Guidelines Recommend:
Multifactorial/Multicomponent Interventions to Address Identified Risk(s) and Prevent Falls

1. A strategy to reduce the risk of falls should include multifactorial assessment of known fall risk factors and management of the risk factors identified. [A]
2. The components most commonly included in efficacious interventions were:
   a. Adaptation or modification of home environment [A]
   b. Withdrawal or minimization of psychoactive medications [B]
c. Withdrawal or minimization of other medications [C]
d. Management of postural hypotension [C]
e. Management of foot problems and footwear [C]
f. Exercise, particularly balance, strength, and gait training [A]

3. All older adults who are at risk of falling should be offered an exercise program incorporating balance, gait, and strength training. Flexibility and endurance training should also be offered, but not as sole components of the program. [A]

4. Multifactorial/multicomponent intervention should include an education component complementing and addressing issues specific to the intervention being provided, tailored to individual cognitive function and language. [C]

5. The health professional or team conducting the fall risk assessment should directly implement the interventions or should assure that the interventions are carried out by other qualified healthcare professionals. [A]

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2021 Medicare Part B Claims Flow for Quality ID #155 (NQF 0101):
Falls: Plan of Care

Disclaimer: Refer to the measure specification for specific coding and instructions to submit this measure.

[Flowchart diagram showing the steps and decision points for the measure.]
SAMPLE CALCULATIONS

Data Completeness:
Performance Met (x=50 patients) + Denominator Exclusion (x=10 patients) + Denominator Exception (b=10 patients) + Performance Not Met (x=30 patients) = 70 patients = 87.59%
Eligible Population / Denominator (b=80 patients) = 80 patients

Performance Rate:
Performance Met (x=50 patients)
Data Completeness Numerator (70 patients) - Denominator Exclusion (x=10 patients) - Denominator Exception (b=10 patients) = 50 patients

* See the posted measure specification for specific coding and instructions to submit this measure.
** Submitting measure #154 is a precursor for submitting this measure. Patients where 110°F without modifier or equivalent (documentation of 2 or more falls or any fall with injury in past year) is submitted in measure #154 are pulled into the denominator for measure #155.

NOTE: Submission Frequency: Patient-Process
2021 Medicare Part B Claims Flow Narrative for Quality ID #155 (NQF 0101):

Falls: Plan of Care

Disclaimer: Refer to the measure specification for specific coding and instructions to submit this measure.

1. Start with Denominator

2. Check Patients aged greater than or equal to 65 on date of encounter:
   a. If Patients aged greater than or equal to 65 on date of encounter equals No, do not include in Eligible Population/Denominator. Stop processing.
   b. If Patients aged greater than or equal to 65 on date of encounter equals Yes, proceed to All eligible instances where CPT II code 1100F is submitted in the numerator for Measure #154.

3. Check All eligible instances where CPT II code 1100F is submitted in the numerator for Measure #154:
   a. If All eligible instances where CPT II code 1100F is submitted in the numerator for Measure #154 equals No, do not include in Eligible Population/Denominator. Stop Processing.
   b. If All eligible instances where CPT II code 1100F is submitted in the numerator for Measure #154 equals Yes, proceed to Patient encounter during the performance period as listed in the Denominator*.

4. Check Patient encounter during the performance period as listed in the Denominator*:
   a. If Patient encounter during the performance period as listed in the Denominator* equals No, do not include in Eligible Population/Denominator. Stop processing.
   b. If Patient encounter during the performance period as listed in the Denominator* equals Yes, include in Eligible Population/Denominator.

5. Denominator Population:
   • Denominator Population is all Eligible Patients in the Denominator. Denominator is represented as Denominator in the Sample Calculation listed at the end of this document. Letter d equals 80 patients in the Sample Calculation.

6. Start Numerator

7. Check Hospice services for patient occurred any time during the measurement period:
   a. If Hospice services for patient occurred any time during the measurement period equals Yes, include in Data Completeness Met and Denominator Exclusion.
      • Data Completeness Met and Denominator Exclusion letter is represented as Data Completeness and Performance Rate in the Sample Calculation listed at the end of this document. Letter x equals 10 patients in Sample Calculation.
   b. If Hospice services for patient occurred any time during the measurement period equals No, proceed to Falls plan of care documented.

8. Check Falls Plan of Care Documented:
   a. If Falls Plan of Care Documented equals Yes, include in Data Completeness Met and Performance Met.
NOTE: Submission Frequency: Patient-proxy

The measure diagrams were developed by CMS as a supplemental resource to be used in conjunction with the measure specifications. They should not be used alone or as a substitution for the measure specification.
Appendix F: Deaths and injuries from fires and falls in the US, ages 60-64.

This appendix displays requested data on emergency department treatment and deaths due to fires and accidental falls among US adults aged 60-64. Numbers were retrieved from the same sources that supplied data for ages 65+, described in detail in the main body of the report.

Table F.1 displays emergency department data related to thermal burns and smoke inhalation. Thermal burns include both burns from residential fires and burns from accidental contact with hot objects and appliances such as stoves, as these are important to the Remembering When home safety program. Smoke inhalation represents the diagnosis anoxia coded as caused by fire involvement.

<table>
<thead>
<tr>
<th>Year</th>
<th>Thermal burns</th>
<th>Anoxia</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>5,494</td>
<td>2,174</td>
</tr>
<tr>
<td>2017</td>
<td>4,792</td>
<td>2,264</td>
</tr>
<tr>
<td>2018</td>
<td>5,894</td>
<td>2,095</td>
</tr>
<tr>
<td>2019</td>
<td>5,265</td>
<td>2,469</td>
</tr>
<tr>
<td>2020</td>
<td>5,302</td>
<td>2,514</td>
</tr>
</tbody>
</table>


Table F.2 displays the number of fire-related deaths reported to the US Centers for Disease Control for the most recent five years, per death certificates.

<table>
<thead>
<tr>
<th>Year</th>
<th>Fire-related deaths, ages 60-64, by year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>295</td>
</tr>
<tr>
<td>2016</td>
<td>303</td>
</tr>
<tr>
<td>2017</td>
<td>311</td>
</tr>
<tr>
<td>2018</td>
<td>314</td>
</tr>
<tr>
<td>2019</td>
<td>302</td>
</tr>
</tbody>
</table>

Table F.3 displays the number of injuries and deaths due to unintentional falls. Methodology is discussed in the main body of the report.

Table F.3. Non-fatal injuries and deaths due to accidental falls, age 60-64, by year

<table>
<thead>
<tr>
<th></th>
<th>Non-fatal injuries, ED visits*</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>524,371</td>
<td>1,400</td>
</tr>
<tr>
<td>2016</td>
<td>536,472</td>
<td>1,453</td>
</tr>
<tr>
<td>2017</td>
<td>518,307</td>
<td>1,603</td>
</tr>
<tr>
<td>2018</td>
<td>527,473</td>
<td>1,575</td>
</tr>
<tr>
<td>2019</td>
<td>524,937</td>
<td>1,680</td>
</tr>
</tbody>
</table>

*Includes those admitted to hospital.

Source: National Center for Injury Prevention and Control, CDC. Emergency department data from NEISS All Injury Program operated by the Consumer Product Safety Commission.
Appendix G: Deaths and injuries from fires and accidental falls in Canada

Fires
Data on deaths and injuries from fires comes from the National Fire Information Database (NFID). NFID is a pilot project that gathers information on fire incidents and fire losses from provincial/territorial Fire Marshals and Fire Commissioners offices across Canada. The NFID is similar to the United States National Fire Incident Reporting System (NFIRS) in that it creates a centralized national system for the collection of fire statistics. Information is collected through a survey using a census of all fire departments in Canada. Responding to this survey is mandatory; however, according to the Canadian Association of Fire Chiefs (2021):

“not all jurisdictions were able to provide the complete 10 years of fire incident and victim information. British Columbia, Alberta, Manitoba, and Ontario all provided at least 10 years of data for both fire incidents and victims. Saskatchewan data only includes data for those municipalities using the US NFIRS.”

Final data for each year are submitted electronically via Statistics Canada's secure electronic file transfer (EFT) site. The latest year available is 2014. Deaths and injuries in the tables below do not include firefighters injured or killed in the line of duty. Unlike for the United States, data by five-year age group is not available online.

<table>
<thead>
<tr>
<th>Injury type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke inhalation</td>
<td>10</td>
<td>8</td>
<td>5</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Burn</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Unknown</td>
<td>39</td>
<td>33</td>
<td>32</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td>Total:</td>
<td>58</td>
<td>48</td>
<td>43</td>
<td>44</td>
<td>36</td>
</tr>
</tbody>
</table>

Table G.2. Fire-related non-fatal injuries, Canada, adults aged 65 or older, by year

<table>
<thead>
<tr>
<th>Injury type</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoke inhalation</td>
<td>19</td>
<td>15</td>
<td>12</td>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>Burn</td>
<td>18</td>
<td>12</td>
<td>15</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Unknown</td>
<td>84</td>
<td>86</td>
<td>71</td>
<td>77</td>
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A recent report (Parachute, 2021) estimated the 2018 direct costs (medical costs) resulting from fires in Canada at $209,742,736 for all age groups (infants to age 85+) combined. Unfortunately, data by age group is not available online.

Falls
Falls data comes from the report Cost of Injury In Canada (Parachute, 2021). Hospital data was provided by the Centre of Surveillance and Applied Research, Public Health Agency of Canada, from the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD). The DAD data did not include hospitalizations for Quebec. Hospitalizations for Quebec were estimated using population proportions. Emergency department data was obtained from the National Ambulatory Care Reporting System (NACRS).
NACRS reporting is complete for Ontario and Alberta only. To obtain an estimate of national emergency department visits, a ratio of emergency department visits to hospitalizations for injury in Ontario was applied to the rest of Canada. Ontario NACRS data were used as Ontario is the largest province in Canada by population.

Table G.3 displays the number of medically treated falls for the most recent year, 2018. Data is presented by ten-year age group.

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According to the same report, direct costs (medical costs) resulting from accidental falls among adults aged 65 years and older were estimated at $5,582,804,652 in 2018.
## Appendix H: US 2017 Actuarial Life Table
(Social Security Administration, 2021)

### Period Life Table, 2017

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* Probability of dying within one year.
* Number of survivors out of 100,000 born alive.

Note: The period life expectancy at a given age for 2017 represents the average number of years of life remaining if a group of persons at that age were to experience the mortality rates for 2017 over the course of their remaining life.

The Social Security area population is comprised of (1) residents of the 50 States and the District of Columbia (adjusted for net census undercount); (2) civilian residents of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands; (3) Federal civilian employees and persons in the U.S. Armed Forces abroad and their dependents; (4) non-citizens living abroad who are insured for Social Security benefits; and (5) all other U.S. citizens abroad.
Appendix I. YLL calculations, US deaths due to fires and accidental falls, age 65+, 2017

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<th>Deaths from fires, male</th>
<th>Deaths from fires, female</th>
<th>Deaths from falls, male</th>
<th>Deaths from falls, female</th>
<th>Years of life lost, each male</th>
<th>Years of life lost, each female</th>
<th>Total YLL, fires, male</th>
<th>Total YLL, fires, female</th>
<th>Total YLL, falls, male</th>
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YLL = Years of life lost
Death data from CDC National Center for Health Statistics, WONDER Online Database (CDC, 2020).
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