
Diabetes and Fall Injury Prevention: A Call to Action

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Introduction

An estimated 18.8 million adults in the US have been diagnosed with diabetes.¹ Among American Indian and Alaska Native (AI/AN) adults, the prevalence of diagnosed diabetes is 2.3 times that of non-Hispanic whites (16.1% vs. 7.1%; 2009).¹ In some AI/AN communities, diabetes rates exceed 60%.²

Persons with diabetes, especially older adults and individuals with long-standing diabetes, are at higher risk of falls and fall injuries.³⁻⁸ In a study of elderly residents of a long-term care facility, for example, the fall incidence rate for the participants with and without diabetes was 78% and 30%, respectively ($p < .001$). The authors concluded that “diabetes mellitus is an independent fall risk factor among elderly nursing home residents. Gait and balance were the only other risk factors independently associated with increased risk of falls.”³

Yet fall injury prevention is an aspect of comprehensive diabetes care that has been relatively neglected. For example, the topic is not listed in the table of contents of popular diabetes management educational materials⁹⁻¹¹ nor in well-recognized diabetes websites.¹²⁻¹⁴

In this article, we outline the risk factors contributing to the higher risk of fall injuries among individuals with diabetes and recommend strategies for incorporating fall prevention activities into the comprehensive care of adults with diabetes.

Fall Risk Factors Relevant to Diabetes

Medical conditions, physical and functional impairments, behavioral factors, medications, and environmental hazards contribute to the risk of falls and fall injuries. The risk of falling increases with the number of risk factors.¹⁵ “Among a cohort of community-dwelling older adults, during one year of follow-up, the risk of falling increased from 8 percent for persons with no risk factor to 78 percent for persons with four or more risk factors.”¹⁶

Diabetes and its complications are associated with many risk factors for fall injuries (Table 1). Despite its length, Table

1 is by no means a complete summary of all relevant factors. Older individuals, and those with long-standing diabetes, are likely to have more risk factors. However, even younger individuals with newly-diagnosed disease may receive more than four medications (polypharmacy), smoke cigarettes, be obese, and exhibit reduced sensation on a monofilament test for peripheral neuropathy, for example.

Medications and medication classes that are associated with falls and which are likely to be prescribed to individuals with diabetes are outlined in Table 2. Of course, the age of the patient, indications, dosage, concomitant medications, comorbidities, possible adverse effects, and other factors are important in deciding whether to prescribe any medication for an individual patient.

Strategies to Promote Fall Injury Prevention Among Persons With Diabetes

Several current national IHS initiatives will undoubtedly contribute to reducing fall risks among AI/AN adults with diabetes. The IHS Working Group on Fall Injury Prevention is preparing a report that highlights both clinical and community-based effective strategies for fall injury prevention.¹⁷ Still in its early stages, the IHS LEAP (Lower Extremity Amputation Prevention) program has joined the IHS Wound Care Initiative, IHS Podiatry Services, and Veterans Administration to promote diabetes foot care, from prevention to comprehensive wound care.^{18,19} The IHS Community Health Representatives (CHR) program has teamed up with the American Association of Diabetes Educators to provide a free, online diabetes certification program for CHRs. The six-module, self-paced program topics include diabetes care guidelines, physical activity, safety, and medication issues.²⁰

To further reduce the likelihood of fall injuries among adults with diabetes, we recommend the following:

1. Promote frequent foot inspections, skilled foot examinations, and monofilament testing for the early detection and management of foot problems and peripheral neuropathy:
 - a. Train outreach workers (ORWs), such as public health nurses and CHRs, to perform foot inspections and monofilament tests during home visits;
 - b. Establish a system for ORWs to document their findings in the electronic health record;
 - c. Collaborate with podiatrists to ensure that

- abnormal screens receive appropriate follow-up and management.
2. Ensure that all patients “participate as actively as possible in a tailored physical activity program involving resistance training, balance exercises, and cardiovascular fitness training.”²²
 - a. Incorporate specific activities (such as balance exercises and Tai chi) aimed at reducing fall risk into existing physical activity programs for persons with diabetes.
 - b. Although not specifically aimed at persons with diabetes, an exercise program in New Zealand for persons 65 years and older resulted in a 35% reduction in falls with simple strength and balance training.²²⁻²⁴
 3. Incorporate falls risk assessment criteria into medication management systems to reduce polypharmacy and the discretionary use of medications contributing to a higher risk of falls. In weighing risks and benefits, medication reviews should consider the number of medications, duplication of medication classes, drug-drug and drug-condition interactions, potentially inappropriate medications and dosages, and medications no-longer-indicated.
 4. Ensure that every person with diabetes receives an annual comprehensive diabetes care visit, including the vision exam, medication review, and complete foot exam with monofilament test.
 - a. Improve the rate of kept appointments for diabetes care through enhanced patient education, outreach services, and appointment reminder approaches.^{25,26}
 - b. Reduce the time burden on providers by instituting group educational classes and peer support meetings.^{27,28}
 5. At each scheduled primary care visit, providers should ask about previous falls; use standardized algorithms to assess falls risk and identify specific risk factors; and refer patients for appropriate clinical care (e.g., physical therapy assessment and management) and community services (e.g., home fall assessment and modifications, exercise classes).
 6. Institute a coordinated approach to fall injury prevention through existing approaches to comprehensive care of persons with diabetes. These approaches include the Special Prevention of Diabetes Initiative, local elder care consortia, and Improving Patient Care Committees.²⁹ Table 3 is a list of potential stakeholders for such an effort.
 7. Promote training in fall injury prevention for providers who treat individuals with diabetes:
 - a. Providers include physicians, podiatrists, physician assistants, nurse practitioners, CHRs, PHNs, physical therapists, and exercise leaders.
 - b. Create an inventory of educational resources including webinars, training videos, falls assessment tools, and patient education materials. Examples of current training resources are the CDC’s STEADI program,³⁰ Q3 Aging video (a 30-minute video on falls prevention and mobility),³¹ and the online resources described by Dr. Scott in this issue of the Provider.
 8. Educate individuals with diabetes, their family members, and other caregivers regarding fall prevention:
 - a. Tailor educational materials to address diabetes-specific risk factors as well as universal ones;
 - b. Utilize multiple avenues for educational materials, such as digital videos and social media, in addition to traditional approaches, such as brochures and community presentations.
 9. Promote research and improve data on diabetes and fall injury prevention:
 - a. Develop evidence-based fall injury risk assessment tools and protocols tailored to individuals with diabetes.
 - b. Evaluate the impact of interventions to reduce fall injuries among persons with diabetes
 - c. Establish a surveillance system for falls and fall injuries among individuals with diabetes.³²
 - d. Monitor the administration and follow-up of monofilament testing as a measurable activity, rather than assuming it is universally performed as a component of a complete foot exam.
 - e. Conduct cost analyses to clarify the burden of fall-related injuries and potential cost savings of fall prevention interventions compared to other health priorities among persons with diabetes.³³
 10. For older persons with diabetes, conduct a comprehensive geriatric assessment (CGA) at least annually, as recommended by the International Association of Gerontology and Geriatrics.²¹ A CGA not only assess physical issues (e.g., gait and balance, medication management, nutritional status, hearing and vision, comorbidities), but also cognition, mental health (e.g., depression, alcohol/substance use), environmental factors (e.g., housing, finances, social support), and activities of daily living (e.g., bathing, dressing, eating, toileting).³⁴⁻³⁷

Conclusion

Categorical programs that target specific problems with effective interventions can be enormously effective. Since the inception of the SDPI, for example, there has been a 10.8% decrease in the mean hemoglobin A1C level of AI/ANs with diabetes. This translates to “an almost 40 percent reduction in diabetes-related complications.”³⁸ IHS programs to reduce

lower extremity amputation rates through early identification and comprehensive management of foot problems have reduced amputation rates by 25 – 90%.³⁹⁻⁴⁰ A concerted effort to reduce fall injury risks could prevent many serious injuries and improve the overall quality of life for American Indians and Alaska Natives with diabetes. An inventory of successful fall prevention initiatives for persons with diabetes within and outside the Indian Health Service would be a valuable starting point.

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Table 1. Fall Injury Risk Factors and Diabetes

Fall injury risk factor associated with diabetes and its complications	Comments
Peripheral neuropathy	<ul style="list-style-type: none"> • “Involvement of the peripheral and autonomic nervous systems is probably the most common complication of diabetes. ⁴¹ • Depending on the study, 20 - 100% of patients with diabetes develop peripheral neuropathy (PN), formally classified as chronic sensorimotor distal symmetric polyneuropathy⁴¹⁻⁴³ • PN can contribute to fall injury risk by impaired proprioception; loss of sensation in the feet leading to foot infections, foot ulcers, amputation; foot drop; pain; gait and balance difficulties. • Diabetic patients with PN were 15 times more likely to experience an injury while walking than matched controls⁴⁴ and 23 times more likely to report instability resulting in a fall or injury.⁴⁵
Peripheral artery disease (PAD)	Poor circulation leads to foot disorders: ulceration, infection, amputation
Vision problems	<ul style="list-style-type: none"> • About 30% of adults over 40 years of age with diabetes have diabetic retinopathy.¹ • Patients with diabetes also are at higher risk of glaucoma, cataracts, and hypertensive retinopathy. • Both diabetic retinopathy and cataracts are associated with increased risk of fractures.⁴⁶
Hearing loss	<ul style="list-style-type: none"> • The prevalence of hearing loss among people with diabetes is nearly double that of persons without the condition.⁴⁷ • “People with a mild (25-decibel) hearing loss were nearly three times more likely to have a history of falling. Every additional 10-decibels of hearing loss increased the chances of falling by 1.4 fold. ⁴⁸ • Possible reasons: hearing loss might result in less awareness of the overall environment, making tripping and falling more likely; also, gait and balance may be impaired by the “cognitive load” imposed by hearing loss.^{48,49}
Hypertension	<ul style="list-style-type: none"> • 2/3 of adults with diabetes have hypertension.¹ • Raises the risk for heart attack, stroke, eye problems, and kidney disease.
Hypotension/orthostatic hypotension	Syncopal episodes.
Specific medications	See Table 2
Multiple medications (polypharmacy = 4 or more)	<ul style="list-style-type: none"> • Average is 4 - 13 medications per patient with diabetes.⁵⁰⁻⁵⁴ • With increasing number of meds there is an increased likelihood of medication duplication, conflicts, adverse effects, and dose errors.^{55,56} • Among AI/AN adults 65 and older, 43% had 4 or more prescriptions.⁵⁵ • Patients with diabetes ages 70 and older in a British general practice were taking an average of seven medications (range, zero to 17). The medications were prescribed for treatment of diabetes, vascular disease risk factors, and coexistent conditions.⁵²

Balance and gait disorders	<ul style="list-style-type: none"> • Detectable gait abnormalities affect 20-40% of adults 65 years of age and older;⁵⁷ • In persons with diabetes, balance and gait disorders result from peripheral neuropathy, peripheral artery disease, foot disorders, stroke, adverse effects of medications, and other causes.
Foot disorders	<ul style="list-style-type: none"> • In a group of persons with diabetes and prior foot ulcers (average age 62), 32% had fixed foot deformities and 58% had insensate feet.⁵⁸ • 15% of patients with diabetes will develop foot ulcers during their lifetime; 5%-10% of patients who develop a diabetes foot ulcer will have a foot or lower limb amputation in their lifetime.⁵⁸
Muscle weakness	May result from limited physical activity due to pain and chronic conditions (e.g., cardiac, renal); adverse effect of medications; and other causes.
Insulin use	Insulin use has been demonstrated to increase the risk of falls in the elderly. Possible mechanisms: hypoglycemia, “marker for disease severity and its complications of reduced balance, strength, and gait abnormalities.” ⁵⁹
Hypoglycemia	Weakness, confusion, dizziness and other symptoms of hypoglycemia can lead to falls.
Hyperglycemia	Drowsiness, fatigue, blurred vision, difficulty concentrating
Nephropathy/kidney disease	<ul style="list-style-type: none"> • Incidence of end stage renal disease is 2.1 times higher in AI/AN vs. overall US population;⁶⁰ • Renal failure can lead to somnolence, leg pain, cognitive impairment; weakness, shortness of breath, heart rhythm disturbances, loss of appetite, fatigue; increased risk of adverse medication effects due to reduced renal clearance.
Nutritional inadequacies	Increased risk of fractures, muscle weakness
Depression	<ul style="list-style-type: none"> • People with diabetes are 2-3 times likely to suffer from depression.^{1,61} • Fall risk due to anti-depressant medications, alcohol misuse, inattention, decreased physical activity.
Smoking	<ul style="list-style-type: none"> • Among AI/AN, smoking rates are 30% with diabetes and 19% without.⁶² • Smoking may contribute to diminished bone mineral density,⁶³ and is associated with increased risk of hip fractures.^{64,65} • Other impacts: vascular impairment (vision, micro-vascular disease), decreased immunity, increased heart and lung disorders, increased risk of peripheral neuropathy
Osteoporosis/ bone density loss	Increased risk of fractures after falling. ⁶⁶
Obesity	<ul style="list-style-type: none"> • In a CDC study of U.S. adults aged >20 years with diabetes in 1999-2002, 55% were obese (BMI ≥ 30 kg/m²).⁶⁷ • Obesity is associated with increased fall risk and increased likelihood of developing disability after a fall.⁶⁸ • Impaired balance, poorer control of blood glucose levels, decreased physical activity, and exacerbation of musculoskeletal pain likely contribute to falls risk.
Heart disease	<ul style="list-style-type: none"> • Adults with diabetes have heart disease mortality rates 2-4 times higher than adults without diabetes.^{1,2} • The risk for cardiovascular in American Indian adults may be 3-8 times higher than in people without diabetes (Strong Heart Study).² • Fall risk due to weakness, medications, arrhythmias. • Cardiovascular diseases are associated with an increased hip fracture risk.⁶⁹

Stroke	<ul style="list-style-type: none"> • Risk for stroke is 2 to 4 times higher among people with diabetes.^{1,70} • Higher risk of falls post-stroke due to urinary incontinence, impaired postural stability, motor/cognitive/visual impairments, and use of diuretics, antidepressants, or sedatives.⁷¹ • Stroke is associated with a higher risk of hip fractures.⁷²
Chronic pain	<ul style="list-style-type: none"> • Common symptom of neuropathies. • Pain can alter mobility, increase fear of falling, decrease overall physical activity
Urinary frequency, nocturia, incontinence	Fall risk due to night-time trips to urinate, sitting/standing from toilet seat
Poor sleep	Resulting from medications, nocturia, anxiety
Cognitive impairment	<ul style="list-style-type: none"> • May result from medications, cerebrovascular disease, and other causes. • “Diabetes patients were 74% more likely to develop dementia of any type over 15 years of follow-up after adjustment for other confounding factors (P=0.004).⁷³
Dizziness, light headedness, somnolence, confusion	<ul style="list-style-type: none"> • May result from polypharmacy, specific meds, hypoglycemia, hypotension, dehydration. • Dizziness can result from vestibular dysfunction, which is 70% more frequent in people with diabetes and carries up to a 12-fold increased risk of falling.⁷⁴

Table 2. Medications and Medication Classes Likely to be Prescribed to Individuals with Diabetes and Its Complications Associated with an Increased Risk of Falls or Fall Injury

<p>Insulin and insulin secretagogues (biguanides, sulfonylureas, thiazolidinediones): hypoglycemia risk</p> <p>Anti-hypertensive medications: can cause orthostatic hypotension</p> <ul style="list-style-type: none"> • Diuretics: vertigo, frequent urination • ACE-Inhibitors - • Beta blockers - <p>OTC sleep medications, including antihistamines</p> <p>Opioid analgesics: sedation, confusion, dizziness, cognitive impairment</p> <p>Anticoagulants: risk of serious bleeding post-fall</p> <p>Psychoactive meds:</p> <ul style="list-style-type: none"> • Benzodiazepines: impair balance, may cause CNS depression • Tricyclic antidepressants: orthostatic hypotension, - 	<p>anticholinergic and sedative effects; used to treat depression or neuropathic pain</p> <ul style="list-style-type: none"> • SSRIs: may induce hyponatremia, which can lead to delirium • Sedatives <p>Class 1A anti-arrhythmics: association with falls may be due to medication effects or the underlying arrhythmias causing hypotension and light-headedness</p> <p>Anticholinergics: dizziness, drowsiness, sedation, blurred vision, lightheadedness</p> <ul style="list-style-type: none"> • Urinary antispasmodics • Gastrointestinal antispasmodics: treatment of diabetic diarrhea • Anticonvulsants: used to treat pain due to diabetic neuropathy pain • Antiemetics <p>Source: References 56,75-77.</p>
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Table 3. Diabetes and Fall Injury Prevention: Potential Partners

<p>Tribal Agencies and Services: Department of Health Health promotion program CHR program Community health Medical and nursing staff Elder Care committee Senior services Behavioral health Social services Family assistance Transportation Diabetes program Special diabetes program Health education Housing</p> <p>IHS National: Diabetes Treatment and Prevention Special Diabetes Prevention Initiative (sp?) LEAP initiative Nursing CHR IHS/AADE CHR diabetes online certification program Other IHS national consultants: medicine, diabetes, optometry, podiatry</p>	<p>IHS Area: Diabetes consultant Injury prevention specialist Behavioral health Information technology</p> <p>IHS locally: Clinical staff: Clinical director, Chief Medical Officer, physicians, NPs, PAs, nursing, pharmacy, podiatry, optometry, physical therapy, occupational therapy Improving Patient Care (IPC) committee EHS/sanitararians Medical records/EHR IPC group Public health nursing Medical records Information Technology</p> <p>State Departments of Health: Injury prevention program Vital statistics Epidemiology Diabetes</p>
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Acknowledgements

Many persons contributed their time and expertise to help us better understand the links between diabetes and fall injury prevention. We are especially grateful to Drs. Ray Delisle and Martha DeVelasco, Dr. Peter Zeigler, LCDR Dolores Addison, Dr. Kendall Shumway, Cathy

Stueckemann, Lorraine Valdez, Dr. Barbara Vize, Patricia Stevenson, Dr. Charles Rhodes, Shawnell Damon, Michael Rinaldi, Cheryl Peterson, Dr. Lisle Ignace, Delsen Liston, Jackie Kizer, Anita Brock, Dr. Ann Bullock, Dr. Christine White, Karla Hackett, and members of the Tohono O’odham Nation/IHS Elder Care Consortium.

Our Apologies

We apologize for the delay in the production of this issue. Constraints on funding at the end of the fiscal year made it impossible to complete the preparation of the issue until now.

We will catch up with our usual monthly publishing schedule as soon as possible. We are currently accepting submissions for the September issue.