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# How to identify balance disorders and reduce fall risk

A multifactorial risk assessment, correction of hearing impairment, exercise, and an optimized home environment can help prevent imbalance-related falls.

## PRACTICE RECOMMENDATIONS

- ▶ *Utilize a falls-prevention program for older patients that focuses on balance and functional exercises.* **(A)**
- ▶ *Perform a multifactorial assessment of the risk of falls in older patients that includes optimizing medications, managing comorbidities, and addressing environmental hazards.* **(B)**
- ▶ *Use a systems-based approach to presentations of imbalance to direct your clinical judgment and highlight the need for referral to specialists for management and rehabilitation.* **(C)**

### Strength of recommendation (SOR)

- (A)** Good-quality patient-oriented evidence
- (B)** Inconsistent or limited-quality patient-oriented evidence
- (C)** Consensus, usual practice, opinion, disease-oriented evidence, case series

## CASE ▶

Mr. J, a 75-year-old man, presents to your family practice reporting that he feels increasingly unsteady and slow while walking. He fell twice last year, without resulting injury. He now worries about tripping while walking around the house and relies on his spouse to run errands.

Clearly, Mr. J is experiencing a problem with balance. What management approach should you undertake to prevent him from falling?

**B**alance disorders are common in older people and drastically hinder quality of life.<sup>1-4</sup> Patients often describe imbalance as vague symptoms: dizziness, unsteadiness, faintness, spinning sensations.<sup>5,6</sup> Importantly, balance disorders disrupt normal gait and contribute to falls that are a major cause of disability and morbidity in older people. Almost 30% of people older than 65 years report 1 or more falls annually.<sup>7</sup> Factors that increase the risk of falls include impaired mobility, previously reported falls, reduced psychological functioning, chronic medical conditions, and polypharmacy.<sup>7,8</sup>

The cause of any single case of imbalance is often multifactorial, resulting from dysfunction of multiple body systems (TABLE 1<sup>7-56</sup>); in our clinical experience, most patients with imbalance and who are at risk of falls do not have a detectable deficit of the vestibular system. These alterations in function arise in 3 key systems—vision, proprioception, and vestibular function—which signal to, and are incorporated by, the cerebellum to mediate balance. Cognitive and neurologic decline are also factors in imbalance.

Considering that 20% of falls result in serious injury in older populations, it is important to identify balance disorders and implement preventive strategies to mitigate harmful consequences of falls on patients' health and independence.<sup>7,57</sup> In this article, we answer the question that the case presentation raises about the proper management approach to imbalance



Almost 30% of people older than 65 years report 1 or more falls annually.

in family practice, including assessment of risk and rehabilitation strategies to reduce the risk of falls. Our insights and recommendations are based on our clinical experience and a review of the medical literature from the past 40 years.

#### CASE ►

Mr. J has a history of hypertension, age-related hearing loss, and osteoarthritis of the knees; he has not had surgery for the arthritis. His medications are antihypertensives and extra-strength acetaminophen for knee pain.

## Making the diagnosis of a balance disorder

### History

■ **A thorough clinical history**, often including a collateral history from caregivers, narrows the differential diagnosis. Information regarding onset, duration, timing, character, and previous episodes of imbalance is essential. Symptoms of imbalance are often challenging for the patient to describe: They might use terms such as *vertigo* or *dizziness*, when, in fact, on further questioning, they are describing balance difficulties. Inquiry into (1) their use of assistive walking devices and (2) development or exacerbation of neuro-

logic, musculoskeletal, auditory, visual, and mood symptoms is necessary. Note the current level of their mobility, episodes of pain or fatigue, previous falls and associated injuries, fear of falling, balance confidence, and sensations that precede falls.<sup>58</sup>

■ **The medical and surgical histories** are key pieces of information. The history of smoking, alcohol habits, and substance use is relevant.

■ **A robust medication history** is essential to evaluate a patient's risk of falling. Polypharmacy—typically, defined as taking 4 or more medications—has been repeatedly associated with a heightened risk of falls.<sup>53,59-61</sup> Moreover, a dose-dependent association between polypharmacy and hospitalization following falls has been identified, and demonstrates that taking 10 or more medications greatly increases the risk of hospitalization.<sup>59</sup> Studies of polypharmacy cement the importance of inquiring about medication use when assessing imbalance, particularly in older patients.

### Physical examination

A focused and detailed physical examination provides insight into systems that should be investigated:

- Obtain vital signs, including orthostatic vitals to test for orthostatic hypoten-

IMAGE: © SCOTT BOPELL

**TABLE 1**

**Symptoms and causes of imbalance, with potential next steps<sup>7-56</sup>**

System	Signs and symptoms and clues in the history	Causes	Referral and other next steps
Peripheral	Impaired proprioception Muscle atrophy Paresthesia	Diabetic neuropathy	Diabetes care team or Endocrinology
	Ataxic gait Confusion Ophthalmoplegia History of alcohol abuse, anorexia nervosa, or bariatric surgery	Thiamine deficiency	Neurology
	Sensorimotor polyneuropathy	Autoimmune disease (Guillain-Barré syndrome, systemic lupus erythematosus) Malignancy (multiple myeloma, paraneoplastic disease) Organ dysfunction (hypothyroidism, renal failure)	Endocrinology, Hematology, Neurology, or Rheumatology
	Hearing loss Tinnitus Vertigo	Benign paroxysmal positional vertigo Labyrinthitis Meniere disease Presbycusis Vestibular neuronitis	Otolaryngology–head and neck surgery Vestibular physiotherapy
Central nervous system	Acute ataxia Hypertension Neurologic symptoms History of vascular disease	Stroke	Neurology Stroke protocol
	Fever Headache Neck stiffness	Meningitis	Emergency medicine
	Ataxic gait Dysarthria Slowly progressive headache	Posterior fossa tumors	Neurosurgery
	Gradual unilateral hearing loss Tinnitus Worsening imbalance	Vestibular schwannoma	Otolaryngology–head and neck surgery Vestibular physiotherapy
	Episodic vertigo Motion sensitivity History of migraine	Vestibular migraines	
	Altered gait History of chronic alcohol abuse	Alcohol-related cerebellar degeneration	
	Bradykinesia Resting tremor Rigidity Slow, shuffling gait	Parkinsonian diseases	Neurology
	Multiple episodes of neurologic dysfunction (ataxia and limb weakness) separated in time and space	Multiple sclerosis	

TABLE 1

Symptoms and causes of imbalance, with potential next steps<sup>7-56</sup> (cont'd)

System	Signs and symptoms and clues in the history	Causes	Referral and other next steps
Cognitive and psychiatric	Poor judgment Slow progression of cognitive impairment	Alzheimer disease	Geriatrics or Neurology
	Dementia Hallucinations Parkinsonism	Dementia with Lewy bodies	
	Focal motor or sensory deficits	Vascular dementia	
	Faintness Dizziness Fear of dying Paraesthesia	Anxiety Depressive disorders	Psychiatry
Biomechanical	Lower-limb joint pain Decreased range of motion Joint deformity	Lower limb osteoarthritis	Orthopedic surgery
	Back pain that improves with flexion Weakness or numbness in lower extremities	Lumbar spinal stenosis	
	Kyphosis Muscle weakness Shortened stature	Osteoporosis	Endocrinology, Orthopedic surgery, or Rheumatology
	Chronic inflammation, nutritional deficiency, or physical inactivity—identified in the context of advanced age Loss of muscle mass Reduced strength and functional capacity	Sarcopenia	Geriatrics
Cardiovascular	Dizziness Dyspnea Exertional chest pain	Coronary artery disease	Cardiology
	Dyspnea Palpitations Syncope	Arrhythmia (eg, atrial fibrillation)	
	Imbalance Right-ventricle dysfunction	Cor pulmonale Pericardial tamponade Pulmonary hypertension Valvular disease	

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sion<sup>62</sup>; keep in mind that symptoms of orthostatic dizziness can occur without orthostatic hypotension.

- Examine gait, which can distinguish between causes of imbalance (TABLE 2).<sup>21,40,63-70</sup>

- Perform a cardiac examination.
- Assess visual acuity and visual fields; test for nystagmus and identify any optic-nerve and retinal abnormalities.
- Evaluate lower-limb sensation, proprioception, and motor function.

CONTINUED

TABLE 1

Symptoms and causes of imbalance, with potential next steps<sup>7-56</sup> (cont'd)

System	Signs and symptoms and clues in the history	Causes	Referral and other next steps
Ophthalmic	Imbalance aggravated by dimly lit rooms Vision loss	Cataracts Glaucoma-causing conditions Macular degeneration	Ophthalmology
Various systems adversely affected by medications	Associated adverse signs and symptoms of antiepileptic medications	—	Medication review and optimization
	Associated adverse signs and symptoms of cardiovascular medications	Antihypertensives Beta-blockers Class 1A antiarrhythmics Digoxin Diuretics Peripheral vasodilators	
	Associated adverse signs and symptoms of diabetes medications	Insulin Thiazolidinediones <sup>a</sup>	
	Associated adverse signs and symptoms of opioids	—	
	Associated adverse signs and symptoms of psychotropic medications	Antidepressants (selective serotonin-reuptake inhibitors, tricyclics) Antipsychotics Benzodiazepines	
	Associated adverse signs and symptoms of vestibulotoxic medications	Aminoglycosides (amikacin, gentamicin, tobramycin) Platinum-based chemotherapy	

<sup>a</sup> Drugs in this class increase the risk of fracture from a fall.

- Evaluate suspected vestibular dysfunction, including dysfunction with positional testing (the Dix-Hallpike maneuver<sup>71</sup>). The patient is taken from sitting to supine while the head is rotated 45° to the tested side by the examiner. As the patient moves into a supine position, the neck is extended 30° off the table and held for at least 30 seconds. The maneuver is positive if torsional nystagmus is noted while the head is held rotated during neck extension. The maneuver is negative if the patient reports dizziness, vertigo, unsteadiness, or “pressure in the head.” Torsional nystagmus must be present to confirm a diagnosis of benign paroxysmal positional vertigo.
- If you suspect a central nervous system cause of imbalance, assess the cranial nerves, coordination, strength, and, of course, balance.

**CASE ►**

Mr. J’s physical examination showed normal vital signs without significant postural changes in blood pressure. Gait analysis revealed a slowed gait, with reduced range of motion in both knees over the entire gait cycle. Audiometry revealed symmetric moderate sensorineural hearing loss characteristic of presbycusis.

**Diagnostic investigations**

Consider focused investigations into imbalance based on the history and physical examination. We discourage overly broad testing and imaging; in primary care, cost and limited access to technology can bar robust investigations into causes of imbalance. However, identification of acute pathologies should prompt immediate referral to the emergency department. Furthermore, specific symptoms (TABLE 1<sup>7-56</sup>) should prompt referral to specialists for assessment.

TABLE 2

**Abnormal gait patterns and associated pathologies**<sup>21,40,63-70</sup>

Gait pattern	Description	Associated pathology
Hemiplegic	<i>Unilateral</i> Adduction of the shoulder Circumduction of the paretic side Flexion of the elbow Internal rotation and extension of the leg Pronation of the wrist	Stroke Brain tumor Subdural hematoma
Diplegic	<i>Bilateral</i> Adduction of the knees Ankles extended and internally rotated Flexion of hips and knees Toes drag during swing phase	Cerebral palsy
Neuropathic	<i>Unilateral or bilateral</i> Distal lower extremity affected Foot drop and toe drag High stepping gait	Guillain-Barré syndrome Multiple sclerosis Spinal-disc herniation
Myopathic	Hyperlordosis Trunk shifts to weight-bearing leg Pelvis tilts to non-weight-bearing side (Trendelenburg sign) Waddling	Hip dislocation Muscular dystrophy Proximal motor neuropathy
Choreiform	Hyperkinetic Involuntary movements in upper and lower extremities Oral or facial dyskinesia	Huntington disease
Cerebellar ataxia	Difficulty on tandem walk Staggering movements Truncal titubation Wide stance	Alcohol ingestion Cerebellar stroke Multiple sclerosis
Sensory ataxia	Deficits in proprioceptive input Foot slams on the ground More evident in the dark Stomping gait	Diabetic neuropathy Vitamin B <sub>12</sub> deficiency
Parkinsonian	Bradykinesia Festination Head and neck in forward stoop Knee flexion Reduced arm swing Small, shuffling steps forward Start-and-turn hesitation Tremors	Atypical parkinsonism Parkinson disease

In the emergency department and academic hospitals, key investigations can identify causes of imbalance:

- Electrocardiography and Holter moni-

toring test for cardiac arrhythmias.

- Echocardiography identifies structural abnormalities.
- Radiography and computed tomogra-

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In our experience, most patients with imbalance and who are at risk of falls do not have a detectable deficit of the vestibular system.

phy are useful for detecting musculoskeletal abnormalities.

- Bone densitometry can identify osteoporosis.
- Head and spinal cord magnetic resonance imaging can be used to identify lesions of the central nervous system.
- Computed tomographic angiography of the head and neck is useful for identifying stroke, cerebral atrophy, and stenotic lesions of the carotid and vertebral arteries.
- Nerve conduction studies and levels of serum vitamin B<sub>12</sub>, hemoglobin A1C, thyroid-stimulating hormone, and random cortisol can uncover causes of peripheral neuropathy.
- Bedside cognitive screening tests can be used to measure cognitive decline.<sup>72</sup>
- Suspicion of vestibular disease requires audiometry and vestibular testing, including videonystagmography, head impulse testing, and vestibular evoked myogenic potentials.

In many cases of imbalance, no specific underlying correctable cause is discovered.

## Management of imbalance

### Pharmacotherapy

Targeted pharmacotherapy can be utilized in select clinical scenarios:

- Medical treatment of peripheral neuropathy should target the underlying condition.
- Cognitive behavioral therapy and antidepressants are useful for treating anxiety and depressive disorders.<sup>73</sup>
- Musculoskeletal pain can be managed with acetaminophen and topical nonsteroidal anti-inflammatory drugs (NSAIDs), using a short course of an oral NSAID when needed.<sup>74</sup>
- Cardiovascular disease management might include any of several classes of pharmacotherapy, including antiplatelet and lipid-lowering medications, antiarrhythmic drugs, and antihypertensive agents.
- Acute episodes of vertigo due to vestibular neuritis or labyrinthitis can be managed with an antiemetic.<sup>46</sup>

### Surgical treatment

Surgery is infrequently considered for patients with imbalance. Examples of indications include microsurgical resection of vestibular schwannoma, resection of central nervous system tumors, lens replacement surgery for cataract, surgical management of severe spinal fracture, and hip or knee arthroplasty in select patients.

### Tools for assessing the risk of falls

Scoring systems called falls risk assessment tools, or FRAT, have been developed to gauge a patient's risk of falling. The various FRATs differ in specificity and sensitivity for predicting the risk of falls, and are typically designed for specific clinical environments, such as hospital inpatient care or long-term care facilities. Specifically, FRATs attempt to classify risk using sets of risk factors known to be associated with falls.

Research abounds into the validity of commonly used FRATs across institutions, patient populations, and clinical environments:

■ **The Johns Hopkins FRAT<sup>a</sup>** determines risk using metrics such as age, fall history, incontinence, cognition, mobility, and medications<sup>75</sup>; it is predominantly used for assessment in hospital inpatient units. This tool has been validated repeatedly.<sup>76,77</sup>

■ **Peninsula Health FRAT<sup>b</sup>** stratifies patients in subacute and residential aged-care settings, based on risk factors that include recent falls, medications, psychological status, and cognition.<sup>78</sup>

■ **FRAT-up<sup>c</sup>** is a web-based tool that generates falls risk using risk factors that users input. This tool has been studied in the context of patients older than 65 years living in the community.<sup>79</sup>

Although FRATs are reasonably useful for predicting falls, their utility varies by patient population and clinical context. Moreover, it has been suggested that FRATs neglect

<sup>a</sup> [www.hopkinsmedicine.org/institute\\_nursing/models\\_tools/jhfrat\\_acute%20care%20original\\_6\\_22\\_17.pdf](http://www.hopkinsmedicine.org/institute_nursing/models_tools/jhfrat_acute%20care%20original_6_22_17.pdf)

<sup>b</sup> [https://content.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/b/b2b\\_1a\\_frat\\_pdf.pdf](https://content.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/b/b2b_1a_frat_pdf.pdf)

<sup>c</sup> [www.ncbi.nlm.nih.gov/pmc/articles/PMC4376110/figure/figure14/?report=objectonly](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4376110/figure/figure14/?report=objectonly)

environmental and personal factors when assessing risk by focusing primarily on bodily factors.<sup>80</sup> Implementing a FRAT requires extensive consideration of the target population and should be accompanied by clinical judgment that is grounded in an individual patient's circumstances.<sup>81</sup>

### Preventing falls in primary care

An approach to preventing falls includes the development of individualized programs that account for frailty, a syndrome of physiologic decline associated with aging. Because frailty leads to diminished balance and mobility, a patient's *frailty index*—determined using the 5 frailty phenotype criteria (exhaustion, weight loss, low physical activity, weakness, slowness)<sup>82</sup> or the Canadian Study of Health and Aging Clinical Frailty Scale<sup>83</sup>—is a useful tool for predicting falls risk and readmission for falls following trauma-related injury. Prevention of falls in communities is critical for reducing mortality and allowing older people to maintain their independence and quality of life.

■ **Exercise.** In some areas, exercise and falls prevention programs are accessible to seniors.<sup>84</sup> Community exercise programs that focus on balance retraining and muscle strengthening can reduce the risk of falls.<sup>73,85</sup> The Choosing Wisely initiative of the ABIM [American Board of Internal Medicine] Foundation recommends that exercise programs be designed around an accurate functional baseline of the patient to avoid underdosed strength training.<sup>54</sup>

■ **Multifactorial risk assessment** in high-risk patients can reduce the rate of falls. Such an assessment includes examination of orthostatic blood pressure, vision and hearing, bone health, gait, activities of daily living, cognition, and environmental hazards, and enables provision of necessary interventions.<sup>73,86</sup> Hearing amplification, specifically, correlates with enhanced postural control, slowed cognitive decline, and a reduced likelihood of falls.<sup>87-93</sup> The mechanism behind improved balance performance might be reduced cognitive load through supporting a patient's listening needs.<sup>88-90</sup>

■ **Pharmacotherapy.** Optimizing medications and performing a complete medication review before prescribing new medications is

highly recommended to avoid unnecessary polypharmacy<sup>7,8,18,53-56</sup> (TABLE 1<sup>7-56</sup>).

■ **Management of comorbidities** associated with a higher risk of falls, including arthritis, cancer, stroke, diabetes, depression, kidney disease, chronic obstructive pulmonary disease, cognitive impairment, hypertension, and atrial fibrillation, is essential.<sup>94-96</sup>

■ **Home safety interventions**, through occupational therapy, are important. These include removing unsafe mats and step-overs and installing nonslip strips on stairs, double-sided tape under mats, and handrails.<sup>73-97</sup>

■ **Screening for risk of falls.** The Centers for Disease Control and Prevention recommends that (1) all patients older than 65 years and (2) any patient presenting with an acute fall undergo screening for their risk of falls.<sup>98</sup> When a patient is identified as at risk of falling, you can, when appropriate, assess modifiable risk factors and facilitate interventions.<sup>98</sup> This strategy is supported by a 2018 statement from the US Preventive Services Task Force<sup>99</sup> that recommends identifying high-risk patients who have:

- a history of falling
- a balance disturbance that causes a deficit of mobility or function
- poor performance on clinical tests, such as the 3-meter Timed Up and Go (TUG) assessment ([www.cdc.gov/steady/pdf/TUG\\_test-print.pdf](http://www.cdc.gov/steady/pdf/TUG_test-print.pdf)).

An increased risk of falls should prompt you to refer the patient to community programs and physiotherapy in accordance with the individual's personal goals<sup>99</sup>; a balance and vestibular physiotherapist is ideally positioned to accurately assess and manage patients at risk of falls. Specifically, the Task Force identified exercise programs and multifactorial interventions as being beneficial in preventing falls in high-risk older people.<sup>99</sup>

### Balance assessment and rehabilitation in specialty centers

An individualized rehabilitation program aims to restore safe mobility by testing and addressing specific balance deficits, improving functional balance, and increasing balance confidence. Collaboration with colleagues from physiotherapy and occupational therapy aids in tailoring individualized programs.

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In addition to visual, proprioception, and vestibular dysfunction, cognitive and neurologic decline are also factors in imbalance.



**>**  
Polypharmacy—typically, defined as taking 4 or more medications—has been repeatedly associated with a heightened risk of falls.

Many tests are available to assess balance, determine the risk of falls, and guide rehabilitation:

- The *timed 10-meter walk test*<sup>d</sup> and the TUG test are simple assessments that measure functional mobility; both have normalized values for the risk of falls. A TUG time of  $\geq 12$  seconds suggests a high risk of falls.
- The *30-second chair stand*<sup>e</sup> evaluates functional lower-extremity strength in older patients. The test can indicate if lower-extremity strength is contributing to a patient's imbalance.
- The *modified clinical test of sensory interaction in balance*<sup>f</sup> is a static balance test that measures the integrity of sensory inputs. The test can suggest if 1 or more sensory systems are compromised.
- The *mini balance evaluation systems test*<sup>g</sup> is similar: It can differentiate balance deficits by underlying system and allows individualization of a rehabilitation program.
- The *functional gait assessment*<sup>h</sup> is a modification of the dynamic gait index that assesses postural stability during everyday dynamic activities, including tasks such as walking with head turns and pivots.
- The *Berg Balance Scale*<sup>i</sup> continues to be used extensively to assess balance.

The mini balance evaluation systems test, functional gait index, and Berg Balance Scale all have normative age-graded values to predict fall risk.

#### CASE ▶

Mr. J was referred for balance assessment and to a rehabilitation program. He underwent

<sup>d</sup> [www.neuropt.org/docs/default-source/cpgs/core-outcome-measures/core-measure-10-meter-walk-test-\(10mwt\)\\_final.pdf?sfvrsn=c5585243\\_2&sfvrsn=c5585243\\_2](http://www.neuropt.org/docs/default-source/cpgs/core-outcome-measures/core-measure-10-meter-walk-test-(10mwt)_final.pdf?sfvrsn=c5585243_2&sfvrsn=c5585243_2)

<sup>e</sup> [www.cdc.gov/steady/pdf/STEDI-Assessment-30Sec-508.pdf](http://www.cdc.gov/steady/pdf/STEDI-Assessment-30Sec-508.pdf)

<sup>f</sup> [www.mdapp.co/mctsib-modified-clinical-test-of-sensory-interaction-in-balance-calculator-404/](http://www.mdapp.co/mctsib-modified-clinical-test-of-sensory-interaction-in-balance-calculator-404/)

<sup>g</sup> [www.sralab.org/sites/default/files/2017-07/Mini-BEST\\_revised\\_final\\_3\\_8\\_13.pdf](http://www.sralab.org/sites/default/files/2017-07/Mini-BEST_revised_final_3_8_13.pdf)

<sup>h</sup> [www.neuropt.org/docs/default-source/cpgs/core-outcome-measures/function-gait-assessment-pocket-guide-proof9-\(2\).pdf?sfvrsn=b4f35043\\_0](http://www.neuropt.org/docs/default-source/cpgs/core-outcome-measures/function-gait-assessment-pocket-guide-proof9-(2).pdf?sfvrsn=b4f35043_0)

<sup>i</sup> [www.ncbi.nlm.nih.gov/books/NBK574518/](http://www.ncbi.nlm.nih.gov/books/NBK574518/)

balance physiotherapy, including multifactorial balance assessment, joined a community exercise program, was fitted with hearing aids, and had his home environment optimized by an occupational therapist. (See examples of “home safety interventions” under “Preventing falls in primary care” on page 27.)

**■ 3 months later.** Mr. J says he feels stronger on his feet. His knee pain has eased, and he is more confident walking around his home. He continues to engage in exercise programs and is comfortable running errands with his spouse. **JFP**

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**➤ All patients older than 65 years and any patient presenting with an acute fall should undergo screening for their risk of falls.**

**Exercise programs should be designed around an accurate functional baseline of the patient to avoid underdosed strength training.**

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