Prediction of fall risk upon admission to an inpatient stroke unit

Usual and standard care assessment yields a feasible, useful model.

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Disclosures

Dr McKenna is an employee of Kessler Institute for Rehabilitation, a Select Medical Corporation.

Dr McKenna is on the speakers bureau for Merz, and Avanir.

No products of those companies will be discussed in this presentation.
Learning objectives

After the presentation attendees will be able to:

Identify fall prediction instruments used in clinical care and the limitations of these instruments.
Describe barriers to comparing fall risk across populations and institutions.
Make clinical observations regarding fall cause/effect and the limitations of clinical observation.
Identify hidden disabilities in stroke patients that contribute to falls and which impact rehabilitation outcomes.
Scope of the problem… even before they come to rehab

• Falls in outpatients
• Fall morbidity and mortality
• Fall as cause of hospitalization
Risk factors for falls
Clinical Assessment of Fall Risk

History

✓ prior history of falls

Medications

✓ Diuretics, sedatives, anti-hypertensives, new medications

Physical Exam

✓ gait, tone, cognition
Fall Prediction Instruments
The imperative for improvement

No Gold Standard
Many instruments exist
Need for disease specific instruments?
Definition of fall (poll)

1. lose one's balance and collapse
2. an event which results in a person coming to rest inadvertently on the ground or floor or other lower level
3. An unplanned descent to the floor (or extension of the floor, e.g., trash can or other equipment) with or without injury.
4. Unintentionally coming to the ground or some lower level and other than as a consequence of sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or an epileptic seizure
5. any unintentional descent to the floor or other horizontal surface
 Definition of Fall

seniors most frequently associated “loss of balance” with falling
When defining falls, health care providers mainly talked about the consequences of falling (injury, health, and anatomical landing point)
Our Definition: An unplanned descent with or without injury.
Safety & Quality Aspects

Risk identification
Prevention
Clinical Impact
Financial/Legal impact
How and where are falls and fall risk data recorded?

Therapy notes
Nurse notes
Physician notes
Coding in ICD-9
Incident Reports
Team meetings
EMR systems
# Clinical Fall Prediction Instruments

<table>
<thead>
<tr>
<th>Name</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
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<tbody>
<tr>
<td>Conley scale</td>
<td>77</td>
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<tr>
<td>Hendrich Risk Model</td>
<td>46</td>
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<tr>
<td>Clinical judgment of RN in inpatient rehab setting</td>
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<tr>
<td>MacAvoy’s Fall Risk Assessment tool</td>
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<tr>
<td>Name</td>
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</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------</td>
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</tr>
<tr>
<td>Berg Balance Test</td>
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<tr>
<td>Elderly Fall Screening Test</td>
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<td>38</td>
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<tr>
<td>Dynamic Gait Index</td>
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<td>38</td>
</tr>
<tr>
<td>Timed Get Up and Go test</td>
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</tr>
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</table>
Sensitivity, Specificity, PPV, NPV

**Specificity**: The capacity of the test to correctly identify diseased individuals in a population “TRUE POSITIVES”. The greater the sensitivity, the smaller the number of unidentified case “false negatives”.

**Specificity**: The capacity of the test to correctly exclude individuals who are free of the disease “TRUE NEGATIVES”. The greater the specificity, the fewer “false positives” will be included.

**Positive Predictive Value**: The probability of the disease being present, among those with positive diagnostic test results.

**Negative Predictive Value**: The probability that the disease was absent, among those whose diagnostic test results were negative.
Non-diseased cases

Diseased cases

Threshold

Test result value
or subjective judgement of likelihood that case is diseased
Non-diseased cases

Diseased cases

Test result value
or
subjective judgement of likelihood that case is diseased
Fall Risk Assessments from therapist and Nursing

Conley Score
Fall wristband
Berg Balance Test
Clinical judgement
Conley Score

Scoring: Score of 2 points or greater, or a fall during hospitalization should initiate fall prevention strategies

The Conley Scale is a 10-point scale that includes the following:

History: On admission, history of falling in last 3 months (2 points)
Observation: Impaired judgment/lack of safety awareness (3 points)
Agitation (2 points)
Impaired gait, shuffle/wide base, unsteady walk (1 point)
Direct: Do you ever experience dizziness or vertigo? (1 point)
Questions: Do you ever wet or soil yourself on way to the bathroom? (1 point)
BERG Patient Name: ____________________________
BALANCE Rater Name: ____________________________
SCALE Date: ____________________________
Balance Item Score (0-4)
1. Sitting unsupported _______
2. Change of position: sitting to standing _______
3. Change of position” standing to sitting _______
4. Transfers _______
5. Standing unsupported _______
6. Standing with eyes closed _______
7. Standing with feet together _______
8. Tandem standing _______
9. Standing on one leg _______
10. Turning trunk (feet fixed) _______
11. Retrieving objects from floor _______
12. Turning 360 degrees _______
13. Stool stepping _______
14. Reaching forward while standing _______
Berg balance Scoring

TOTAL (0–56): _______
Interpretation
0–20, wheelchair bound
21–40, walking with assistance
41–56, independent
Role of Tone in Falls

Spasticity (Ashworth, pectoral muscle reflex)
Paratonia (Kral’s modified test of paratonia)
Parkinsonism (Pull Test)
Modified Ashworth Scale for grading Spasticity Grade

Description
0  No increase in muscle tone
1  Slight increase in muscle tone, manifested by a catch and release, or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
2  Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of movement (ROM)
3  More marked increase in muscle tone through most of ROM, but affected part(s) easily moved
4  Considerable increase in muscle tone, passive movement difficult
5  Affected part(s) rigid in flexion and extension
Cognitive Aspects of Fall Risk

Go/No Go Brain Systems

- 3-gesture test
- Luria’s modified test of echopraxis

Aphasia

spatial neglect

- Physical exam, bedside pen and paper screen

Dual task

Ecological validity
Science of Fall Prediction

Current methods:
fall wristband
Standardized instrument
Clinical Judgment
Are there separable items which can be used to predict fall risk?
Standardized Instruments: Why use them?
KEY ELEMENTS FOR ASSESSING RISK OF FALLS AND MANAGING PATIENTS AT RISK

Step 1: Ideally for all patients but especially those with gait dysfunction
HPI: Inquire about falls in past year
And
History: Stroke, Age ≥ 65 years, Dementia, Vision deficit, Arthritis, arthralgia, Parkinsonism, Depression, Peripheral neuropathy, Polypharmacy, Use of cane or walker, Other condition w/ LE Restricted ADLs, sensorimotor loss
Physical Exam

Physiatric examination, emphasizing:
balance and gait
LE strength, sensation & coordination
mental status
In addition, may consider a standardized assessment
Hidden Disabilities in stroke

No transfer records

Walk in the room

Which brain hemisphere?

Except when it’s not
How do each of these contribute to fall risk?

• Aphasia
• Apraxia
• Spatial neglect
• Anosagnosia
Rapid bedside assessment

Observe
Ask
Examine
Management

May address:
Underlying disorder
Adjustment of medication
Exercise program
Training in gait and balance
Training in assistive device
Assessment/modification of home environment
Fracture risk: BMD, Vit D
From research to real world
From lab to bedside.

The research presented today is supported by Select Medical and Kessler Foundation
Background of Current Research

- Falls in stroke patients represent a significant source of morbidity. Accurate identification of patients at high risk of falling may enable appropriate distribution of fall prevention resources which will in turn enhance care quality and in turn facilitate patient recovery.

- Although this problem has been approached by other research groups, there is no single clinically accepted and widely used instrument, thus further work in this area is warranted.

- We have developed a model that correlates factors measurable within the first 72 hours of admission. We intend to use this set of correlations to develop a predictive model of falls.
Objective

To develop a model to predict falls in the inpatient stroke patient population using data stemming from admission documentation and relevant to the rehabilitation population of patients. These factors were chosen because they are routinely collected data on every stroke inpatient.
Methods

- Retrospective chart analysis to develop model
- Prospective chart analysis to test model
- 3112 consecutive stroke patients undergoing inpatient acute rehabilitation
Study Design
Pertinent data

- Functional Independence Measure (FIM)
- Demographic information
- Case mix group (CMG), which incorporates the presence or absence of comorbidities
Functional Independence Measure (FIM)

18 Items

- Motor skills (13), Cognitive (5)
- Scale of 1 (total assist) to 7 (no assist)
- Ranges 13-91 Motor, 5-35 Cognitive
- Higher scores = Better function
- Range of total score: 18-126
FIM Subsets

• self-care (nutrition, hygiene, and dressing)
• sphincter control, mobility (transfer to bed, chair, and toilet)
• locomotion (walking and climbing stairs)
• communication (comprehension and expression)
• cognitive function (social relations, problem solving, and memory)
## Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Patients who Fell</th>
<th></th>
<th>Patients who did not fall</th>
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<tbody>
<tr>
<td></td>
<td>Characteristic</td>
<td>mean</td>
<td>Std. Deviation</td>
<td>mean</td>
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<tr>
<td>age (years)</td>
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<td>56.7</td>
<td>12.8</td>
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<td>Female, n (%)</td>
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<td>1409 (50.1)</td>
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<td>136 (45)</td>
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<td>Tier</td>
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</table>
Results

• Gender  M>F

• Age   Younger>older

• Case mix group (CMG) and Tier assignment Complexity level
Significant FIM scores

Admission FIM scores which contribute in a statistically significant manner to the prediction:

- eating
- bed transfer
- stairs
- walking and wheelchair ability
- bowel accident frequency
Effect of FIM on falls

The admission FIM score subsets which contributed in a statistically significant manner to the fall-correlation model were eating, stairs, and toilet transfer.

The high performing to low performing comparison for eating revealed a hazard ratio of 1.15; for stairs hazard ratio was 0.691, p-value 0.01; for toileting hazard ratio was 1.3, p-value 0.06
Factors Correlated with Falls

Gender was correlated with falls, with males being more likely to fall. The female vs. male hazard ratio was 0.727, p-value 0.04.

Older patients’ fall risk appeared to be lower than younger patients with patients in the group age 63 or less being more likely to fall than those older than 63. The age hazard ratio was 0.982, p-value 0.003.

CMG which incorporates the presence or absence of comorbidities was also correlated with falls. Increasing burden of CMG had a hazard ratio of 1.3, p-value of 0.0001
Select Medical Innovative Fall Predictor for Stroke Inpatients SeMIFall

Sensitivity (60%)
Specificity (58%)
Positive predictive value (13.8%)
Negative predictive value (93.9%)
Patients identified to be high fall risk who fell (true positives) 75

Patients identified to be high fall risk who didn’t fall (false positives) 467

Falls that happened in patients who were not identified as high fall risk (false negatives) 50

Patients who did not fall and who were correctly identified to be not at risk for falling (true negatives) 657
What is SeMIFall?

The SeMIFall is a novel fall prediction instrument based on subsets of FIM, demographics, and medical stratification systems such as case mix groups and tiers. Further work in this area will seek additional factors to improve the sensitivity and specificity of this test.
Implications for Practice

Our results suggest that stroke patients who fall during their inpatient stay can be identified within the first 72 hours of admission to acute rehabilitation.

This instrument uses no additional time beyond routine clinical assessments.
Prediction of fall risk upon admission to an inpatient stroke unit: usual and standard care assessment yields a feasible, useful model.

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Types of falls (poll)

accidental falls
anticipated physiologic falls
unanticipated physiologic falls
extrinsic
Hospital-Acquired Conditions
Inpatient Prospective Payment System (IPPS) Fiscal Year (FY) 2009 Final Rule, CMS included 10 categories of conditions that were selected for the HAC payment provision.

The 10 categories of HACs include:
1. Foreign Object Retained After Surgery
2. Air Embolism
3. Blood Incompatibility
4. **Stage III and IV Pressure Ulcers**
5. **Falls and Trauma**
   1. Fractures
   2. Dislocations
   3. Intracranial Injuries
   4. Crushing Injuries
   5. Burns
   6. Electric Shock
6. Manifestations of Poor Glycemic Control
7. **Catheter-Associated Urinary Tract Infection (UTI)**
8. Vascular Catheter-Associated Infection
9. Surgical Site Infection Following: CABG, Bariatric Surgery, Orthopedic Procedures
10. Deep Vein Thrombosis (DVT)/Pulmonary Embolism (PE):
    Total Knee Replacement, Hip Replacement

https://www.cms.gov/hospitalacqcond/06_hospital-acquired_conditions.asp
Affected Hospitals

The Present on Admission (POA) Indicator requirement and Hospital-Acquired Conditions (HAC) payment provision only apply to Inpatient Prospective Payment Systems (IPPS) Hospitals. At this time, the following hospitals are exempt from the POA Indicator and HAC: Critical Access Hospitals (CAHs) Long-term Care Hospitals (LTCHs) Maryland Waiver Hospitals Cancer Hospitals Children's Inpatient Facilities Rural Health Clinics Federally Qualified Health Centers Religious Non-Medical Health Care Institutions Inpatient Psychiatric Hospitals Inpatient Rehabilitation Facilities Veterans Administration/Depart of Defense Hospitals
Which types of falls are we held responsible for?

Community fall risk
CMS perspective on falls
Unintended consequences
Fall Risk Perspectives

Within disease

Within institution

Individual
Summary

Clinical: How to identify and manage fall risk in your patients
Research: Impact of prediction of fall risk on function
Standardized Scales
Hidden disabilities
Alarm Fatigue
Alarm Fatigue

Relationship to falls
Avoiding adverse event
Improving outcomes
Personalized therapy plan
Helpful resources

http://www.rehabmeasures.org
http://www.aan.com/go/practice/guidelines
http://www.strokecenter.org/professionals/
http://www.cdc.gov/HomeandRecreationalSafety/Falls/index.html


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What to do ?!?!?

Open floor for discussion