Physical Design Strategies to Reduce Patient Falls

Dr. Debajyoti Pati, Professor
Texas Tech University

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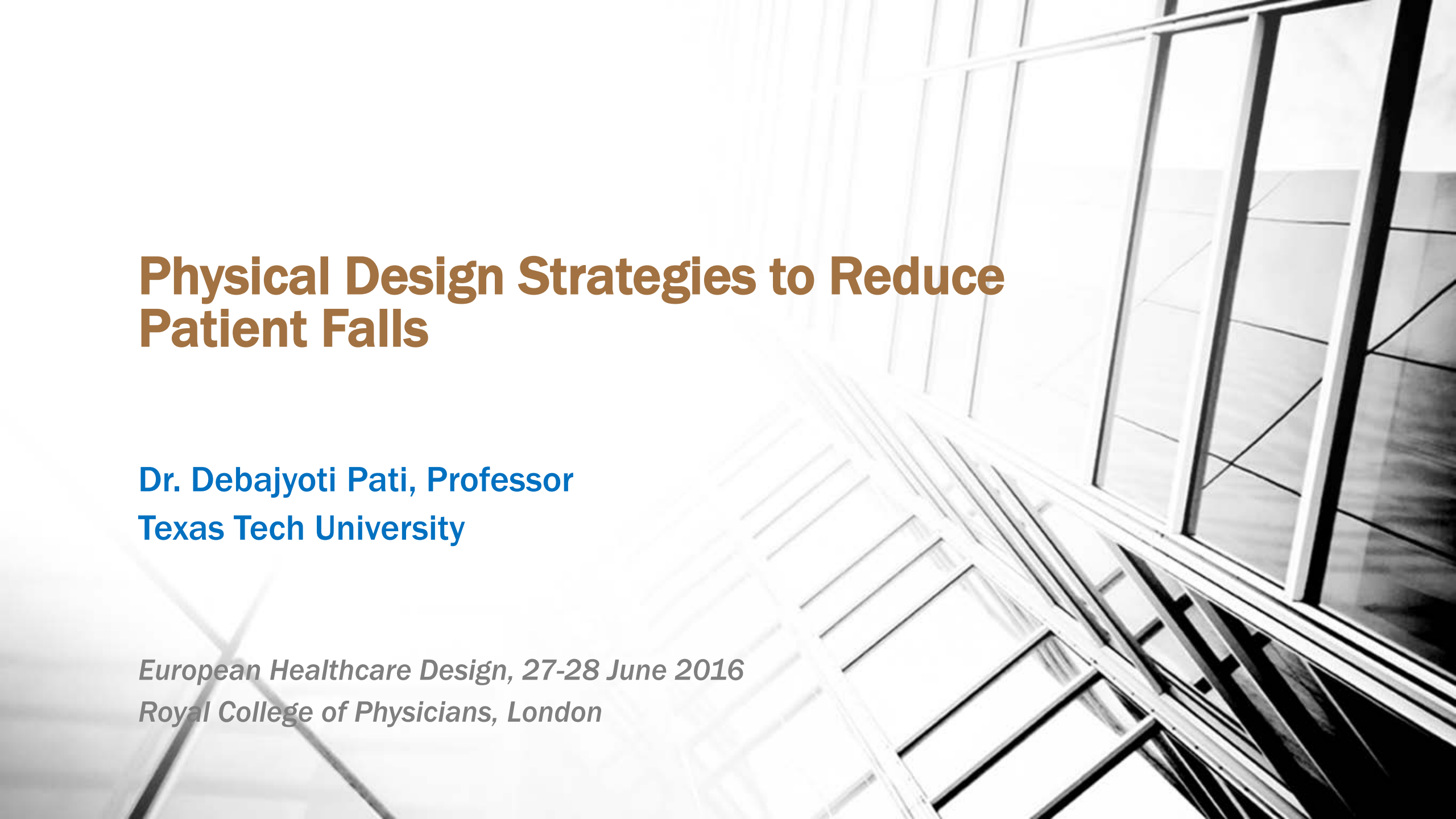

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National Patient Safety Foundation®

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Agenda

Importance
Sources of Fall
Study Question
Method
Key Findings
Implications

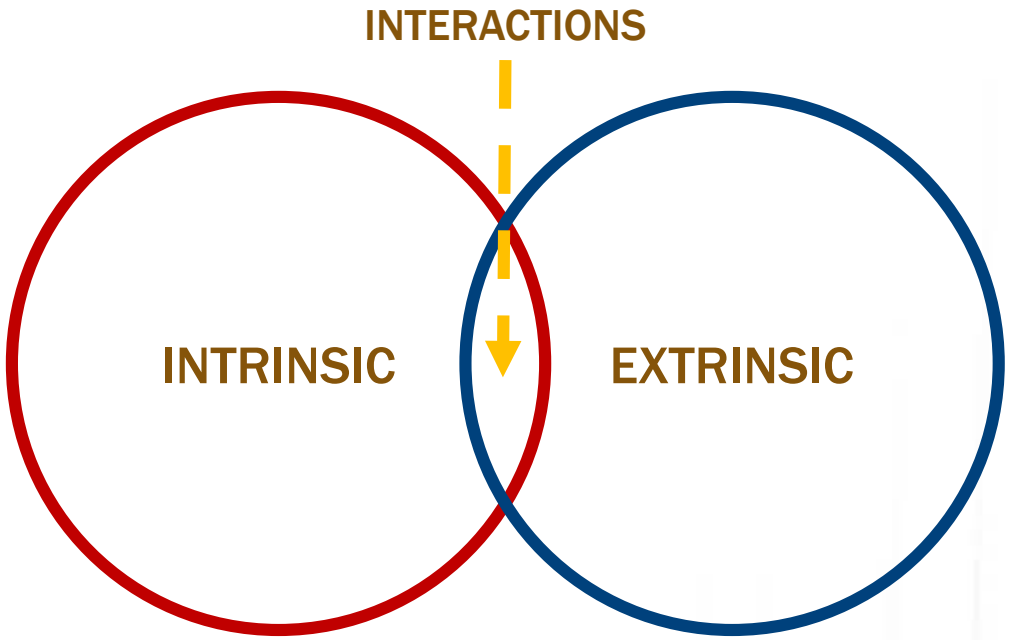
IMPORTANCE

Fall is a Major Problem

- Affects all – patients, family, providers…
- Painful, expensive, and life threatening
- $34 billion annually in direct medical cost
- 6.5% of reported sentinel events
- Common occurrence in hospital bedrooms and bathrooms
- Is a *NEVER EVENT*
- Affects more elderly
- Rapid aging of the U.S. population

SOURCES OF FALL

Fall Risk Factors



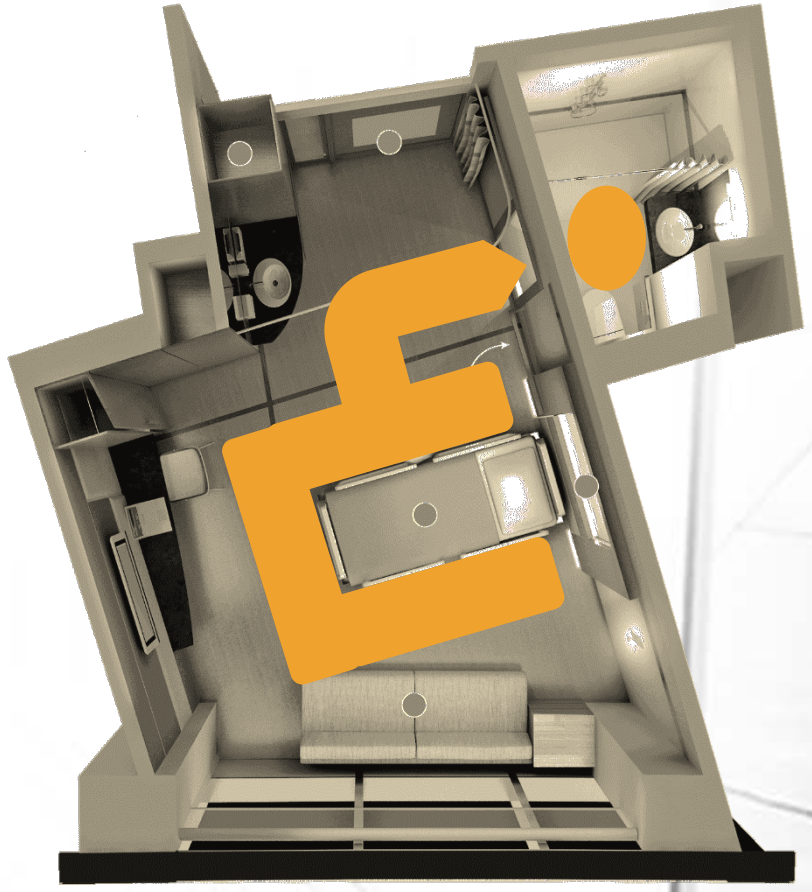
Age
Gender
Physical Factors
Mental Factors
Physiological Factors
Medications
...

Physical Environment
Care Process
Care Culture
...

What is Known

- Location (2/3rd of all falls):
  - Around the bed
  - Path to bathroom
  - Inside bathroom

- Calkins et al 2012 relational study:
  - Headwall vs footwall bathroom location
  - Bathroom door (open/close)
  - Toilet location (side/opposite wall)
  - Number of grab bars
  - Grab bar location
  - Shower threshold
  - Family area
  - Flooring type



STUDY QUESTIONS

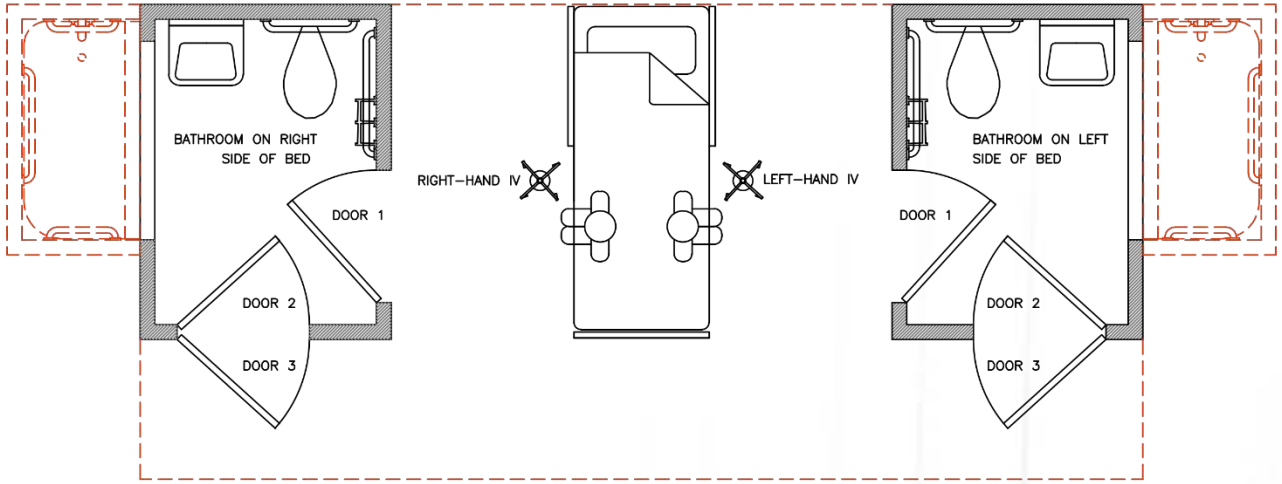
Questions

1. From a physical design perspective, what are the specific decisions pertaining to patient room design that may contribute to fall events?

2. What are their relative orders of importance?

METHOD

Physical Design

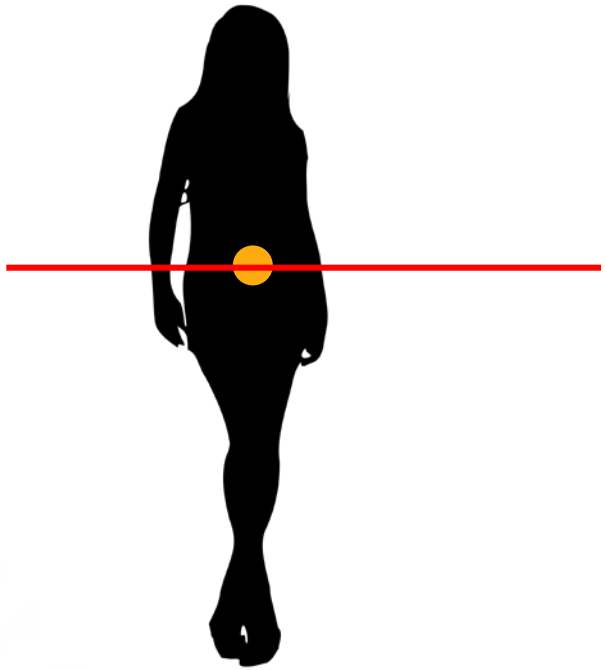


Key Attributes Courtesy HKS, Inc. Archives

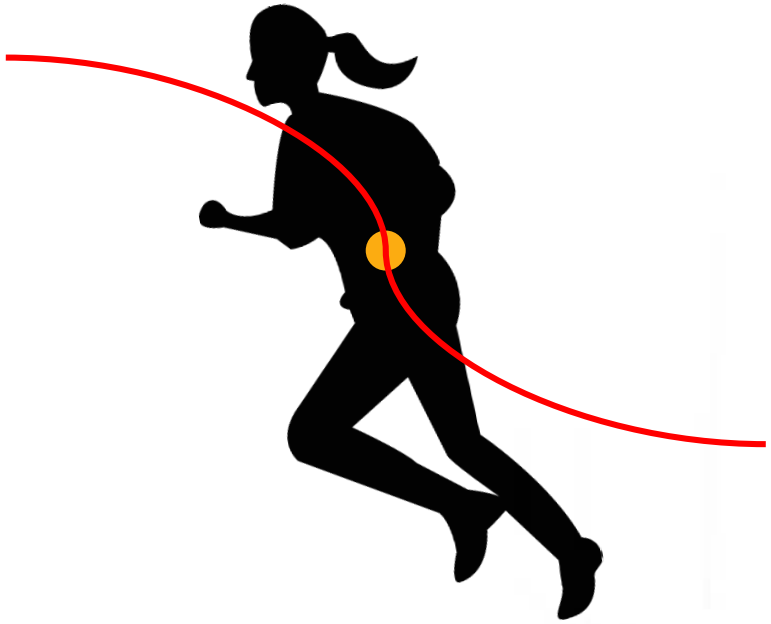
Bathroom location
Bathroom door
Door swing
IV on arm

Center of Mass

Consistent increase in the ‘jerk trajectory’ of the center of mass = Fall Initiation



Stable Acceleration



Jerk in Acceleration

Research Plan

- 1st Stage: Fall scenarios and script development
- 2nd Stage: Experiments

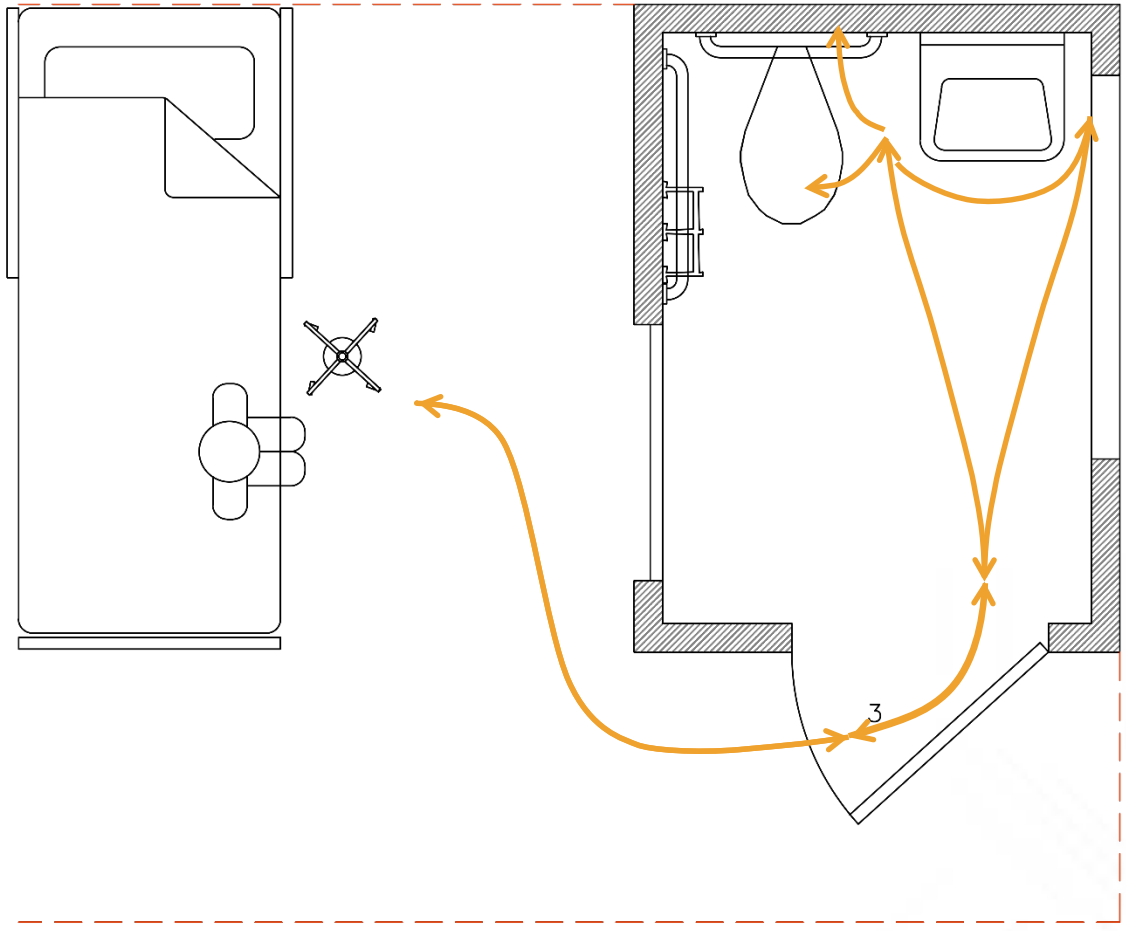
Script

- Contributor: Covenant Falls Committee
  - Industry data
  - Covenant system general trend

- *Location*
- *Intention*
- *Travel Path*
- *…*

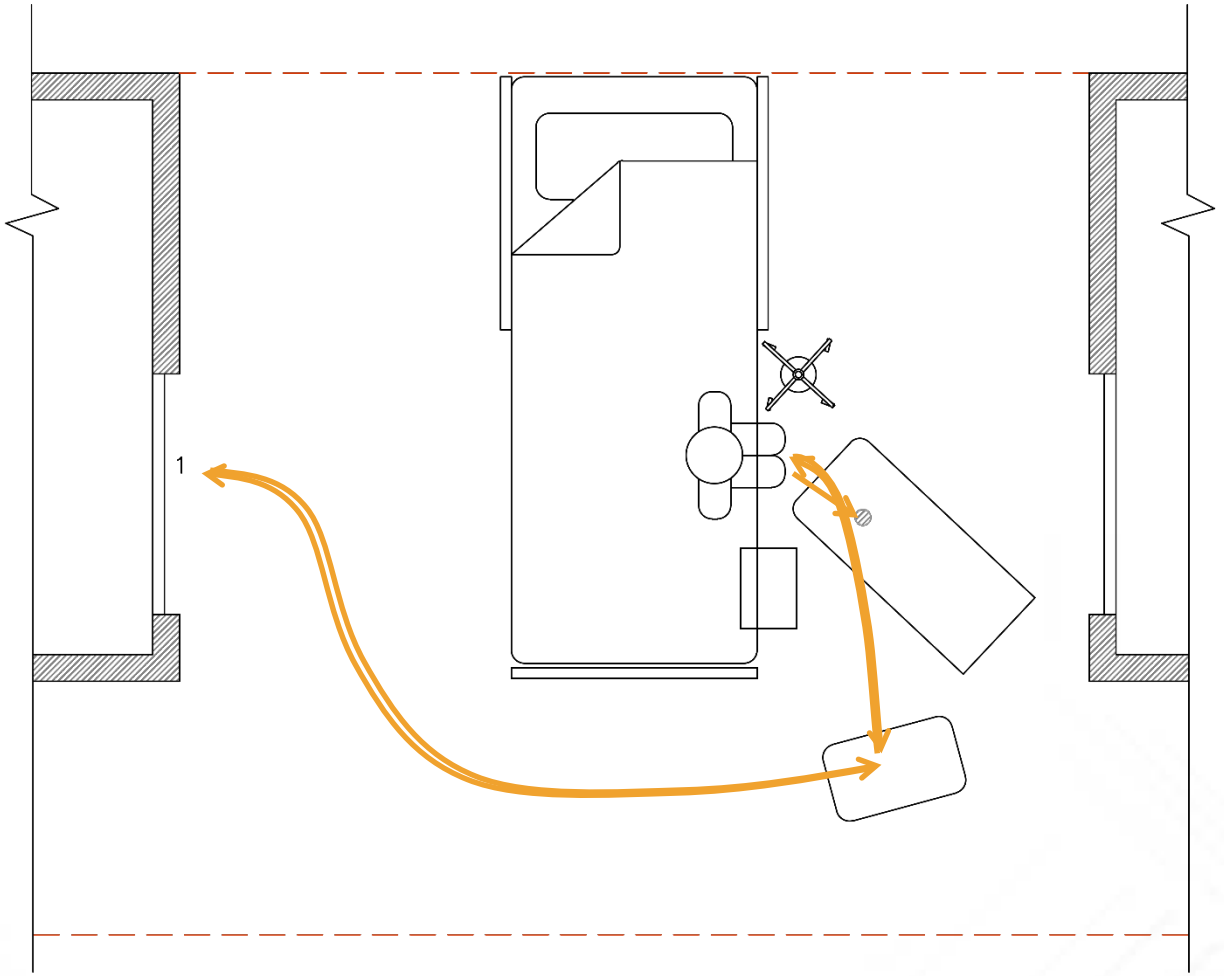
Question:	Examples:	Patient #1	Patient #2	Patient #3	Patient #4	Patient #5	Patient #6
1 Point of Origin: Where was the patient's starting point before the fall?	(bed, chair, sink,…)	Bed	Chair – patient was tired	Bed	Bed	Bed	Bed. Had bed alarm but not on at the time for unknown reason.
2 Destination Point: Where was the patient's destination when they fell?	(sink, toilet, shower,…)	Bathroom	Bed – to rest	Bathroom	Bedside commode	Bathroom	To the door to her patient room
3 What was the patient traveling to the bathroom to do?	(shower, shave, brush teeth, use toilet, blow nose, dry hair, vomit,…)	Use the toilet	Go to bed to lay down and rest	Use the toilet	Use the toilet	Use the toilet	Unknown
4 What did the patient use while in the bathroom?	(sink, soap dispenser, tissue roll, trash can, towel on rack, shower door/curtain, shower, bathtub, shower chair,…)	Tissue roll	Nothing in the bathroom	Tissue roll	Tissue roll	Tissue roll	Wheelchair
5 What was the patient doing at the time of the fall?	(trying to get off the bed, trying to open the bathroom door, trying sit or rise from the toilet, trying to access the toilet tissue roll, trying to get into/out of the shower, trying to dry hair, trying to walk to bathroom or back to bed/chair,…)	Moving over due to not being able to get tissue roll and fell into shower	Stood up & slipped (thought he could make it on his own, but was weaker than he thought	Bending forward to clean self	Trying to get off the bedside commode which was just beside the bed. Patient had taken oxygen mask off. Patient tends to drop her oxygen level to the 60s % which leads to light-headedness. Not compliant with repeated instructions	Trying to pull tissue from dispenser, not enough space, was getting ready to clean self, struggled to remove tissue from dispenser and had to pull hard, lost balance and slipped off commode.	In bed, bed alarm wasn't on at change of shift. Patient up without assistance to door (?). All that we heard was door slamming shut. Patient fell behind door slamming it. Patient was status post craniotomy (recent brain surgery). Patient's behavior following surgery impulsive.
6 What was the patient's starting posture before the fall?	(bending, sitting, standing, lying,…)	Scooting to left to make room to pull tissue roll	Sitting in chair, alone in room	Bending forward	Trying to stand, slid to the floor	Sitting	Unknown. Patient awake but confused. Unable to tell us if she hit her head or what she was trying to do. No apparent injury. No redness to scalp, only abrasion to elbows and knee.

Bathroom



Example of script performing in bathroom

Clinician Zone

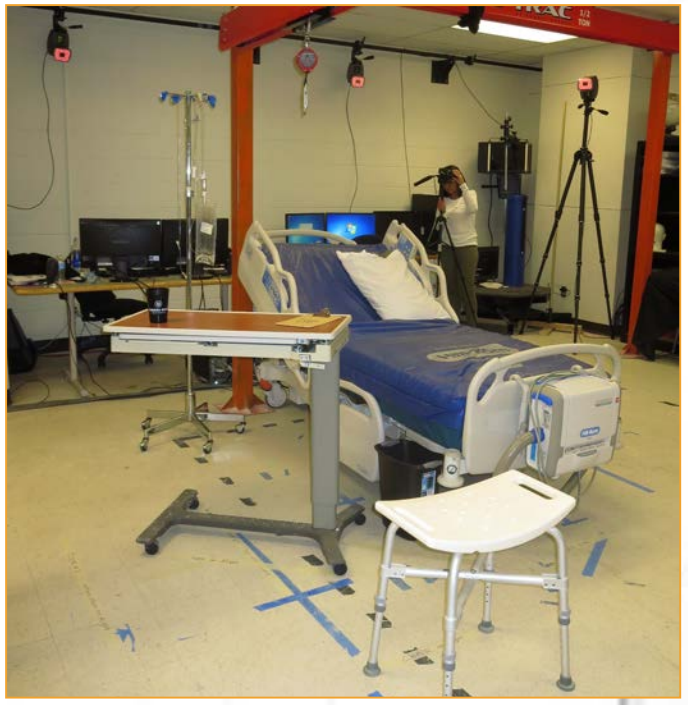


Example of script performing in clinical zone

Motion Capture

Setting

- Human-Centric Design Research (**HCDR**) Lab
- Eight Eagle-4 **infrared camera system** from Motion Analysis, Inc.
- 10’ x 10’ x 8’ **motion capture** volume
- Fall arrest **harness system** from McMaster-Carr
- Two camcorders



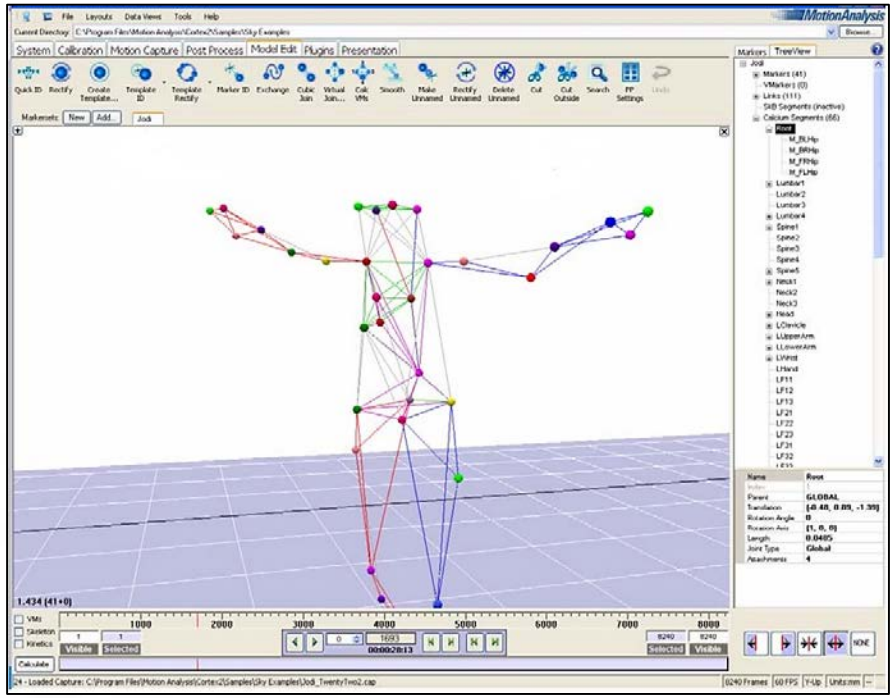
Subjects :: Trials

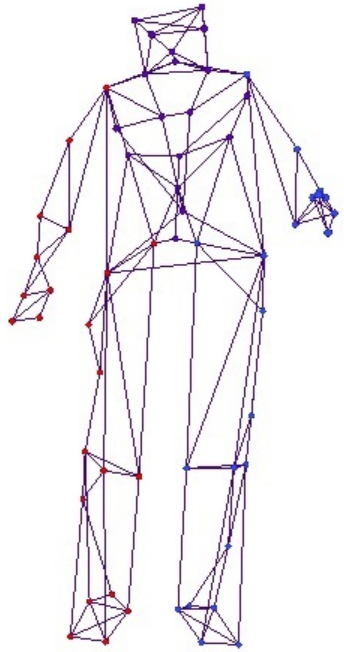
- Subjects
  - 27 subjects
  - 70 to 87 years (mean 78)
  - Male (11), Female (16)
  - Caucasian (23), Hispanic (4)

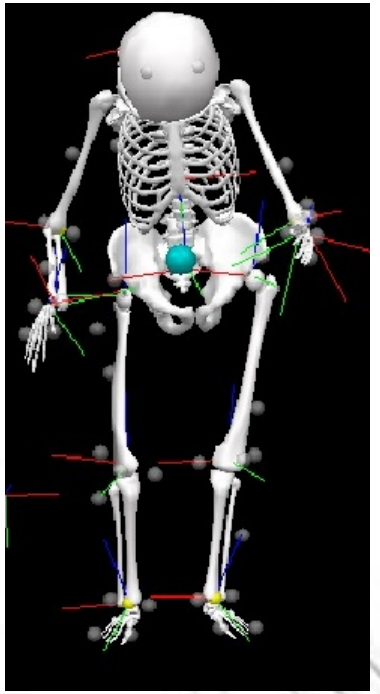
- Trials
  - 200 x 3 = 600 runs
  - Best 200 used for motion capture analysis
  - Each run: 2 to 4 minutes

Data Processing

Cortex - Marker Labeling
Visual3D – COM tracking
MATLAB – Jerk calculation + identification



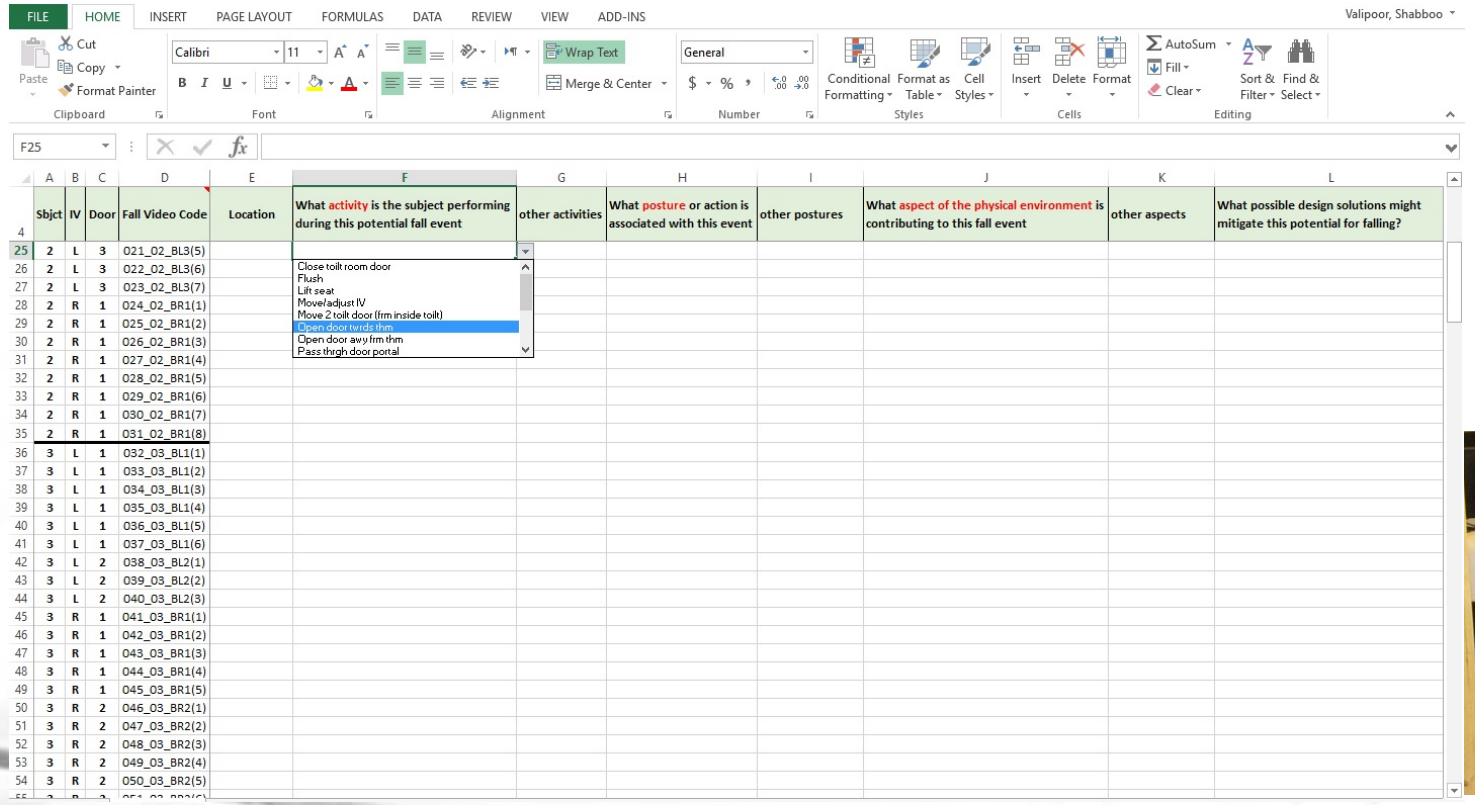




Fall Moments

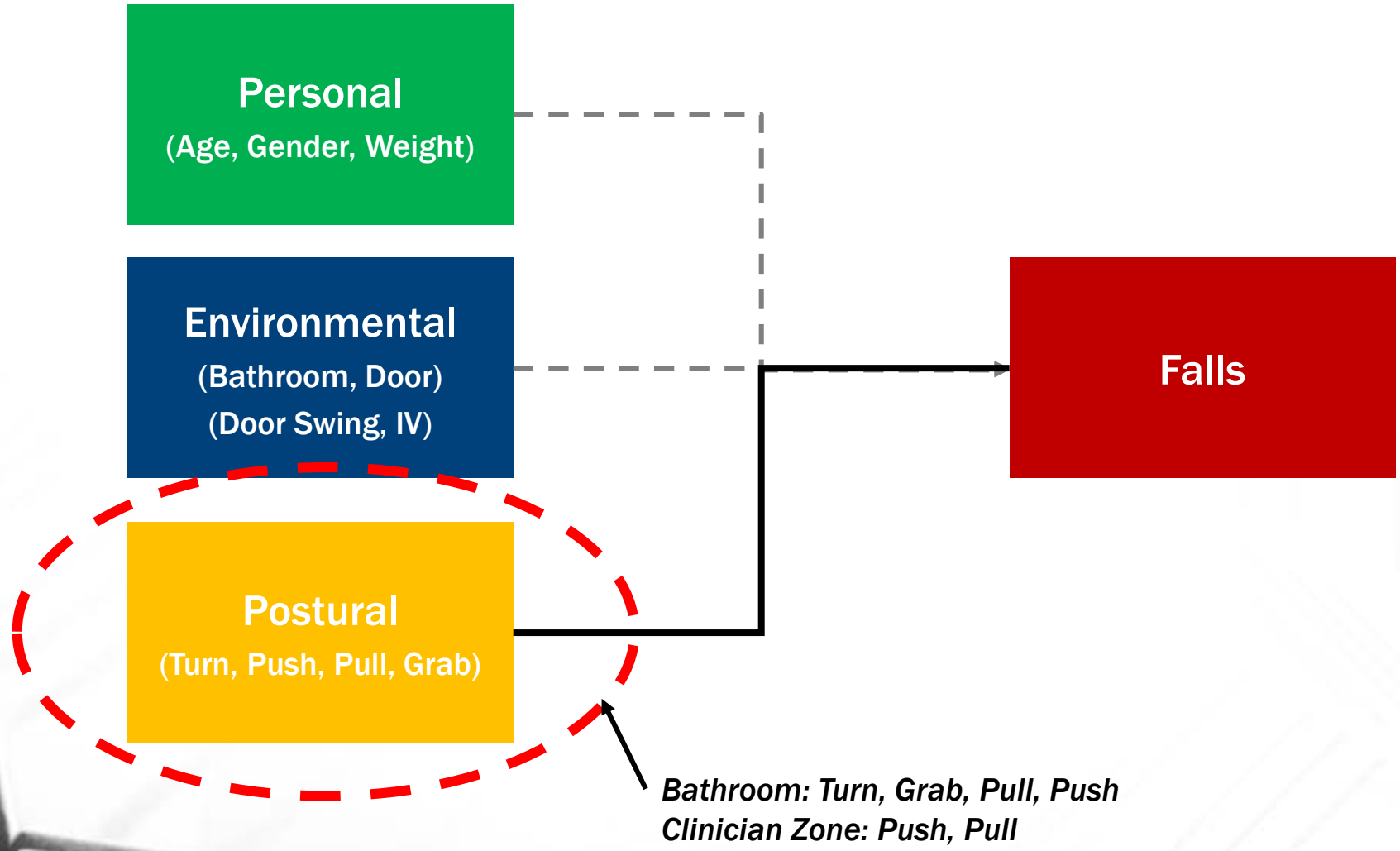
- Video data coding:
  - Fall Committee members
  - Healthcare Architects

- Inter-rater reliability: Very good



FINDINGS

Significant Factors



Design Attributes: Bathroom

- High frequency factors:
  - **Configuration** - forcing turn within bathroom free space
  - **Door type** (swinging door used in the study as opposed to or distinct from other door types)
  - **Direction of door swing** (whether into or out of space served by the door; towards or away from oneself)
  - **IV management** (physical design attributes/elements interacting with actions to render IV management challenging)
  - **Space available** (crowding/congestion in immediate vicinity of the observed action)
  - **Size of door opening** (bathroom door clear opening when fully open)
  - **Hardware location** (physical location of hardware pertaining to door, toilet, or sink or the distance from other physical objects, floor, and walls)
  - **Toilet seat height** (too far to drop in sitting posture before finding seat).

Design Attributes: Clinician Zone

- High frequency factors
  - **IV management** (physical design attributes/elements interacting with actions to render IV management challenging)
  - **Space available** (crowding/congestion in immediate vicinity of the observed action)
  - **Configuration** – forcing turns within clinician zone free space

Thank You!