RX360 · BALANCE METER

How the algorithm works

Two-layer architecture · 5 evidence-grounded additions · 4 worked vignettes

Rx360 Pharmacy Operations · clinical algorithm explainer

Prepared by Gene Lang, PharmD — Director of Pharmacy Operations · 2026-05-20

BIG PICTURE

Two layers — who is this person, and what's changing

Static baseline risk and live deviation are clinically different. We model them separately, then combine — Layer 1 sets where you start; Layer 2 moves the needle day to day.

LAYER 1 · Baseline risk

Who is this person?

Computed at onboarding from evidence-based predictors. Slow-changing — only updates when an input changes (new medication, new fall, annual re-check).

Inputs:

- Fall history (from the STEADI fall-screen questionnaire + multiple/injurious)
- Mobility & function (STEADI 2–7)
- Sensory / physiologic (STEADI 9, 10 + orthostatic)
- Mood (worry about falling, depression)
- Medications — FRID (fall-risk-increasing drugs) by class + polypharmacy
- Conditions (8 with literature-OR weights)
- 2 super-additive interaction bonuses

LAYER 2 · Live monitoring

What is changing right now?

Continuous from the wearable's sensors. Compares the wearer's gait to her own personal baseline — never to other people.

Inputs:

- Daily walking cadence, speed, regularity
- Δ-thresholds gate scoring (e.g., gait speed must drop 15%)
- Device-detected acute events (falls, stumbles)
- Personal baseline — 30 days stable; shorter after a change

Layer 1 sets the floor and tightens Layer 2's sensitivity — a high-baseline wearer trips "Some Change" at smaller gait drift than a low-baseline wearer.

BUILDING ON THE v1 FRAMEWORK

Most of the framework is preserved — we restructured a few pieces and added the behavioral inputs it didn't have

PRESERVED · kept verbatim
9 items

- 5-tier weighted model (Tier A → E)
- Tier A weighted highest — including fall history
- All Tier B gait inputs (speed, asymmetry, sway, double-support)
- All Tier D physiologic inputs (orthostatic, HRV, sustained HR)
- All 11 v1 FRID medication classes
- Polypharmacy ≥4 Rx threshold
- Vision + cognitive as condition inputs
- Δ-thresholds (gait must drop ≥15% before scoring)
- Personal-baseline framing; 30-day cadence (7–14d after change)

RESTRUCTURED · v1 inputs, reshaped
7 items

- 5-tier model → 2-layer architecture (static + dynamic separated)
- Medications: Tier B overlay → standalone tier (per 5/12 decision)
- Fall history: Tier A entry → Layer 1 dominant + granularity (binary → single/multiple/injurious)
- Conditions: 2 named (vision, cognition) → 8-item explicit checklist
- Polypharmacy: single ≥4 threshold → tiered (≥4: +3, ≥8: +6)
- The v1 "individualized adjustment for multi-drug" → diminishing-returns curve + 2 named interactions
- 11 drug classes → 5 named + "other FRID" lump (Ie 2021 / Richardson 2014: antidep + benzo carry most signal)

ADDED · genuinely new inputs
7 items

- STEADI 12-item self-report screen as Layer 1 backbone
- Mobility aid use as named explicit input
- Worry about falling (Ellmers 2025 / Landers 2015)
- Urinary urgency (STEADI mechanism)
- Depression (WFG 2022)
- 5 additional named conditions: stroke, neuropathy, vertigo, hearing, arthritis
- Mathematical structure: category caps + diminishing-returns curve

9 preserved · 7 restructured · 7 added · the v0.6 spec stands on the v1 foundation, not next to it

BUILDING BLOCKS

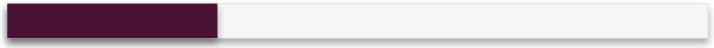
The 6 categories that build the Layer 1 baseline score

Each category contributes points to a 0–100 baseline. Caps prevent any one category from dominating. The next slides walk through each — and why we weight it that way. (OR = odds ratio: how much a factor multiplies fall risk.)

Fall history
Cap · 30 of 100 pts

Have you fallen? Multiple? Injurious?

STRONGEST single predictor (OR 2.8–3.5)

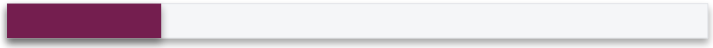


≤ 30% of total possible

Medications
Cap · 22 of 100 pts

Prescription med list + interactions

Rx360 moat — saturates at ≥2 FRIDs

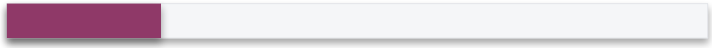


≤ 22% of total possible

Conditions
Cap · 22 of 100 pts

8 named conditions, each weighted

Each with literature-OR weight



≤ 22% of total possible

Mobility & function
Cap · 18 of 100 pts

Walker · unsteady · sit-to-stand · curb

OR 2.2–3.1 for mobility aid

≤ 18% of total possible

Sensory / physiologic
Cap · 14 of 100 pts

Orthostatic · foot sensation · meds dizziness

OR 1.73 orthostatic alone

≤ 14% of total possible

Mood
Cap · 10 of 100 pts

Worry about falling · depression

Strong subjective predictors

≤ 10% of total possible

What goes in, and why we weight it this way

Fall history
Cap · 30 of 100 pts

WHAT THE WEARER ANSWERS

Have you fallen in the past year? (STEADI #1) *Anchor question — OR 2.8, dominant single predictor*	**+15**
How many times? — 2 or more *Recurrent fallers: OR 3.5 (Deandrea)*	**+10**
Was anyone injured / saw a doctor? *Injurious falls — higher OR + worse consequence*	**+8**
Where did it happen? — indoor / outdoor *Captured for pharmacist context — not scored*	**detail**

WHY THESE WEIGHTS

OR 2.8 for any faller, 3.5 for recurrent — the strongest single predictor across 74 prospective studies. Weights scaled to match: 15 pts for any fall captures the dominant signal; gradations add 10 + 8 for the higher-OR sub-groups. Cap at 30 matches the v1 framework weighting and reflects fall history as the top contributor — exactly where the literature places it.

Lit: Deandrea 2010 (Epidemiology meta-analysis, 74 studies, ~100k participants)

Mobility & function
Cap · 18 of 100 pts

WHAT THE WEARER ANSWERS

Use a cane or walker? (STEADI #2) *Observable behavior — strongest of the mobility items*	**+10**
Feels unsteady when walking (STEADI #3) *Self-report mobility item*	**+2**
Grabs furniture or walls at home (STEADI #4) *Compensatory behavior*	**+2**
Pushes off with hands to stand up (STEADI #6) *Lower-body weakness proxy*	**+2**
Trouble stepping up or down from a curb (#7) *Functional decline proxy*	**+2**

WHY THESE WEIGHTS

Mobility aid OR 2.2–3.1 — observable, strong predictor → 10 pts. The four STEADI self-report items each add 2 because together they capture cumulative functional decline, but no single one is decisive. Cap at 18 prevents 5 yes-answers from stacking past where the literature supports.

Lit: Deandrea 2010 (mobility aid OR); STEADI scoring (items 2–7)

What goes in, and why we weight it this way

Medications
Cap · 22 of 100 pts

WHAT THE WEARER ANSWERS

Antidepressants (per drug, diminishing returns) *Strongest FRID class signal (Ie 2021)*	+6→
Benzodiazepines (per drug) *Sedation + balance impairment*	+6→
Opioids (per drug) *Alertness + steadiness*	+5→
Sedatives / hypnotics (per drug) *Z-drugs, etc.*	+4→
Anticholinergics (per drug) *Cognitive / autonomic burden*	+3→
Other FRIDs (antihypertensives, etc.) *Weaker but additive signal*	+1→
Polypharmacy (≥4 Rx +3, ≥8 Rx +6) *Independent risk beyond FRID count*	+3/+6

WHY THESE WEIGHTS

Per-class weights from the meta-analytic OR data (Ie 2021, Richardson 2014) — antidepressants and benzos carry most of the predictive signal. Each additional drug in a class adds less than the previous one (diminishing returns: 100% → 70% → 50% → 30%) matching Park 2015 / Beunza 2018 dose-response curves. Cap at 22 matches Ie

Conditions
Cap · 22 of 100 pts

WHAT THE WEARER ANSWERS

Parkinson's disease *OR 2.7 (Deandrea)*	+15
Stroke or TIA history *Documented predictor*	+8
Cognitive concern / dementia *Plus interaction with polypharmacy*	+12
Vertigo, BPPV, inner-ear *OR 1.8–2.3 (Deandrea)*	+8
Peripheral neuropathy / diabetes feet *Sensation + foot pain*	+6
Vision problems (cataracts, etc.) *Visual contribution to balance*	+5
Severe arthritis affecting walking *Functional limitation*	+5
Hearing difficulty *Multisensory contribution*	+3

WHY THESE WEIGHTS

Each condition has a documented OR from the geriatric-falls literature; weights are tiered to those OR values. Parkinson's gets the highest weight (15) because of its outsized

What goes in, and why we weight it this way

Sensory / physiologic
Cap · 14 of 100 pts

WHAT THE WEARER ANSWERS

Orthostatic check (Mark II band-guided, or report) *HR rise ≥20 bpm or BP drop*	+10
Feet feel numb or less sensitive (STEADI #9) *Peripheral neuropathy marker*	+4
Medicine sometimes makes you dizzy (STEADI #10) *Subjective med-effect signal*	+3

WHY THESE WEIGHTS

Orthostatic hypotension has OR 1.73 across 50,000+ participants (Mol 2019) — robust predictor → 10 pts. Foot sensation loss precedes falls (neuropathy literature) → 4 pts. Self-reported lightheadedness from meds adds 3 — captures what the wearer notices that we wouldn't otherwise see. Cap 14: prevents the physiologic signal from stacking past what's clinically defensible.

Lit: Mol 2019 orthostatic meta · STEADI items 9, 10

Mood
Cap · 10 of 100 pts

WHAT THE WEARER ANSWERS

Worry about falling (STEADI #5) *Not really / Sometimes / Often*	0 / +4 / +8
Depression severity (STEADI #12) *None / Mild / Significant*	0 / +3 / +6

WHY THESE WEIGHTS

Worry about falling has OR ~1.6 across 75,000 participants (Ellmers 2025 meta). Landers 2015 found balance confidence explained 38% of fall variance — beating every physical test in that cohort. Severity gradation (Not really / Sometimes / Often) lets the score reflect intensity rather than binary yes/no. Depression added per 2022 WFG recommendation. Cap 10: mood is a screening signal, not a deciding factor.

Lit: Ellmers 2025 · Landers 2015 · World Falls Guidelines 2022

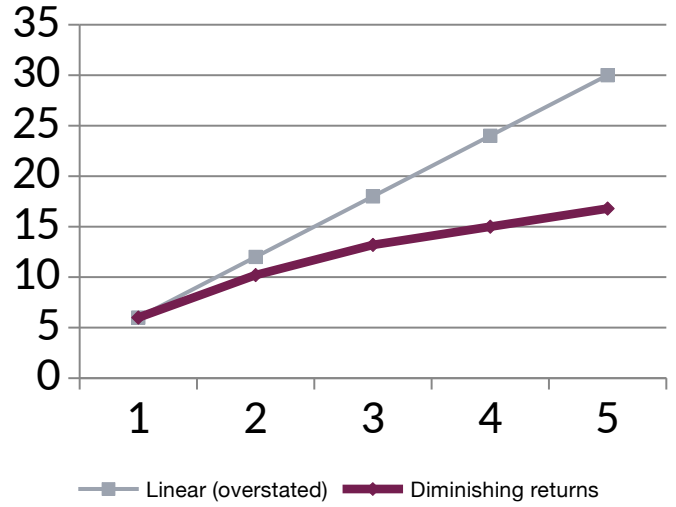
THE MATH IN PICTURES

How risk factors combine — three mechanisms, all evidence-grounded

Real-world fall risk doesn't combine linearly. Three mechanisms make the model match the published curves.

1 · DIMINISHING RETURNS

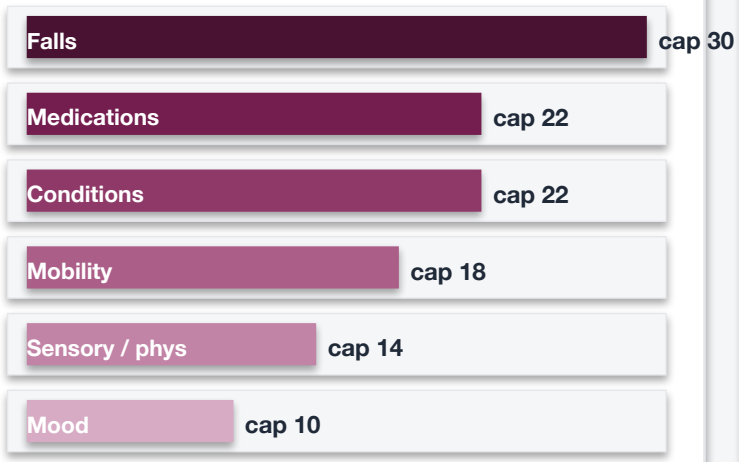
Within each medication class — saturation curve



Matches the FRID dose-response in Park 2015 + Beunza 2018 meta-analyses.

2 · CATEGORY CAPS

Each category has a clinically grounded ceiling



Caps fire at ~95th percentile of realistic profiles — invisible for typical patients, bite for extreme.

3 · INTERACTIONS

Two super-additive combinations only

Orthostatic + antihypertensive +5

Combined OR ~3–4 vs. ~1.7 for either alone (Mol 2019). Mechanism: syncope-driven falls.

Cognitive + polypharmacy (≥4) +5

Multiplicative in dementia-falls literature. Mechanism: medication-management errors.

Two only — beyond these we'd be modeling regression without outcome data.

FROM SCORE TO BALANCE METER

How the internal score becomes what the wearer actually sees

The wearer never sees the 0–100 number. The Layer 1 baseline lives in the pharmacist's clinical view. The wearer sees a band state in plain language — what's different right now, and why we think so.

LAYER 1 · BASELINE

Pharmacist clinical view

76

of 100 · example: Mrs. B

Static. Set at onboarding. Changes only when a major input changes — a new med, a new fall, an annual re-check.

LAYER 2 · LIVE CHANGE

Pharmacist clinical view

+18%

gait cadence drop vs. her own baseline

Live. Measured continuously from the wearable. Compared only to her personal normal — never to other people.

BALANCE METER · WEARER

Plain-language band state

Some Change

"A bit different from your usual — likely tied to the new gabapentin started 5 days ago."

No score. No diagnosis. Just a state + a likely reason.

HOW THE TRANSLATION WORKS

Layer 1 (Mrs. B at 76) tightens the threshold for what counts as Some Change. At baseline 76, ~12% gait drift trips Some Change — at baseline 30, she'd need 15%. Same drift, different band depending on standing risk.

WHAT THE BALANCE METER IS — AND WHAT IT ISN'T

IS: A barometer of change from the wearer's own normal. A wellness signal. A reason to mention something to your pharmacist.

IS NOT: A clinical prediction that she will fall. A diagnostic device. A reason to change medications without a clinician.

HOW IT'S POWERED

From data sources to what each person sees

Three things to follow: where each input comes from, where the score is computed, and where it shows up.

1 · WHERE THE DATA COMES FROM

Medication list

Pharmacist-verified · Medicare Blue Button · or typed in by hand

Intake answers

Falls, conditions, orthostatic, mood — answered by the wearer, a caregiver, or a pharmacist at setup

Gait & movement

The band's motion sensors, all day

2 · WHERE IT'S COMPUTED

Layer 1 — baseline

From the intake answers + medications. Set at onboarding; recomputed only when an input changes.

Layer 2 — live deviation

From the band's gait signal. Computed continuously against the wearer's own 30-day normal.

3 · WHERE IT SHOWS UP

Wearer + caregiver app

The band — Steady / Some Change / Notable Change — plus a likely-contributor line. No number.

Pharmacist clinical view

The 0–100 score, the category breakdown, and a recommended action.

Required: the band + the phone app. Everything else degrades gracefully — the band still works with no pharmacist and no Medicare link (meds typed in). Pharmacist verification upgrades confidence; it is never a gate.

VIGNETTE · MRS. A · MODERATE

One prior fall, an SSRI + sleep med, occasional worry — a typical moderate-risk patient

Layer 1 contribution on a 0–100 scale

Baseline · 34 / 100

Fall history
+15 · 44%

Mobility
+2 · 6%

Mood
+4 · 12%

Medications
+13 · 38%

LAYER 1 BASELINE

34

Moderate — pharmacist clinical view

WHAT'S DRIVING IT

Fall history	**+15 pts**
Mobility	**+2 pts**
Mood	**+4 pts**
Medications	**+13 pts**

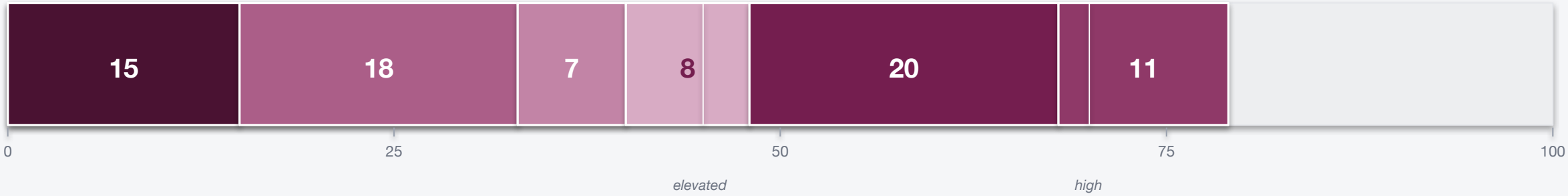
Her 34 comes mostly from the prior fall (now correctly weighted as the dominant predictor) plus an SSRI + sleep med. No mobility aid, no cognitive concern, no orthostatic. Pharmacist sees a watchable patient — not urgent.

VIGNETTE · MRS. B · CHRONIC HIGH-RISK

Walker, multiple STEADI items, 3 FRID classes, polypharmacy — chronic high-risk, no acute trigger

Layer 1 contribution on a 0–100 scale

Baseline · 79 / 100



Fall history	Mobility	Sensory / phys	Mood	Medications	Conditions
+15 · 19%	+18 · 23%	+7 · 9%	+8 · 10%	+20 · 25%	+11 · 14%

LAYER 1 BASELINE

79

High — pharmacist clinical view

WHAT'S DRIVING IT

Fall history	**+15 pts**
Mobility (at cap)	**+18 pts**
Sensory / phys	+7 pts
Mood	+8 pts
Medications	**+20 pts**
Conditions	**+11 pts**

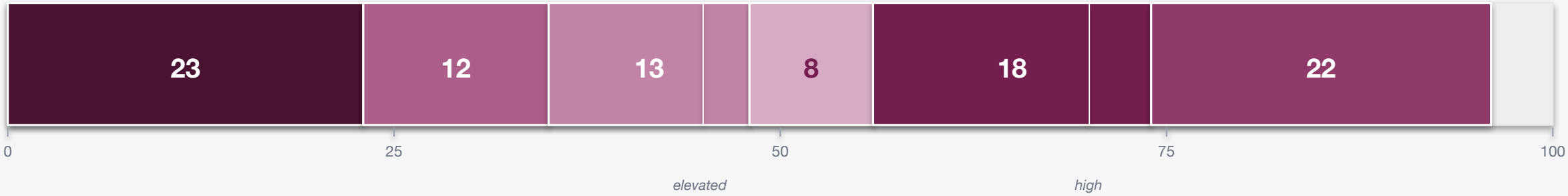
Her 79 is broadly distributed across categories — chronic high-risk, no single category dominating. Mobility hits the cap (18) exactly. Pharmacist response: review the FRID stack and the home environment.

VIGNETTE · MRS. C · ACUTE HIGH-RISK

Just had an injurious fall, on new opioid+benzo+sedative, cognitive concern, orthostatic-positive

Layer 1 contribution on a 0–100 scale

Baseline · 96 / 100



Fall history	Mobility	Sensory / phys	Mood	Medications	Conditions
+23 · 24%	+12 · 12%	+13 · 14%	+8 · 8%	+18 · 19%	+22 · 23%

LAYER 1 BASELINE

96

High — pharmacist clinical view

WHAT'S DRIVING IT

Fall history	+23 pts
Mobility	+12 pts
Sensory / phys	+13 pts
Mood	+8 pts
Medications	+18 pts
Conditions (at cap)	+22 pts

⚡ **Interaction firing: Cognitive × polypharmacy (+5)**

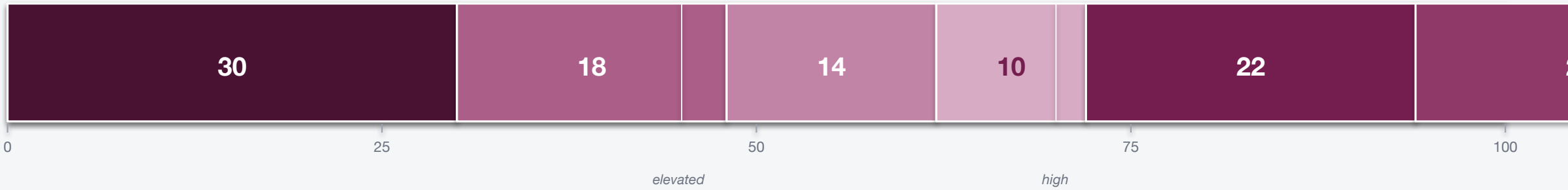
Her 96 outranks Mrs. B's 79 because (a) fall history is now properly dominant (the recent injurious fall + new meds) and (b) the cognitive × polypharmacy interaction fires. This is exactly the patient the model is designed to flag hardest.

VIGNETTE · MR. D · COHORT CEILING

Every category maxed — the stress-test profile that demonstrates the caps doing their work

Layer 1 contribution on a 0–100 scale

Baseline · 100 / 100



Fall history	Mobility	Sensory / phys	Mood	Medications	Conditions
+30 · 26%	+18 · 16%	+14 · 12%	+10 · 9%	+22 · 19%	+22 · 19%

LAYER 1 BASELINE

100

Capped at ceiling — pharmacist clinical view

WHAT'S DRIVING IT

Fall history (at cap)	+30 pts
Mobility (at cap)	+18 pts
Sensory / phys (at cap)	+14 pts
Mood (at cap)	+10 pts
Medications (at cap)	+22 pts
Conditions (at cap)	+22 pts

⚡ **Interaction firing: Orthostatic × antihypertensive (+5) · Cognitive × polypharmacy (+5)**

Mr. D's raw pre-cap score crosses 160. After every category cap engages (including both interactions), he lands at the 100 ceiling. Fall history dominates as it should (30 — recurrent injurious), medications contribute substantially but no longer outweigh fall history (22).

VALIDATION ANCHOR

Does our score agree with validated fall-risk tools?

Our 0–100 baseline isn't directly comparable to validated scales (different ranges, different cutoffs). But the risk band each vignette lands in should agree across tools. It does.

Vignette	Our baseline	STEADI (0–14)	TUG (sec)	Berg (0–56)	SPPB (0–12)	Verdict
Healthy 72F	0	0	~9	~52	~11	**All: low**
Mrs. A · moderate	34	5 (at risk)	~12–13	~47–50	~9–10	**All: borderline / at-risk**
Mrs. B · high	79	12	~15–18	~38–42	~6–7	**All: high**
Mrs. C · high	96	8	~16	~35–40	~5–6	**All: high**
Mr. D · ceiling	100	14 (max)	>20	<30	≤4	**All: extreme**

TUG = Timed Up & Go · Berg = Berg Balance Scale · SPPB = Short Physical Performance Battery (standard clinic fall tests). These estimates are projections — each vignette would land in the same risk band on those tools. Our model flags the same patients those screens would, plus the inputs they miss (continuous monitoring, medication detail, interactions).

STAYING IN LANE

Two views — the wearer sees attention, the pharmacist sees the score

WHAT THE WEARER + CAREGIVER SEE

Band card · plain language only

Steady

"No change this week."

Some Change

"A bit different — likely tied to the new gabapentin."

Notable Change

"Worth mentioning to your pharmacist when convenient."

No number. No "fall risk score". No advice — only observation + suggestion.

WHAT THE PHARMACIST SEES

Clinical view · numeric + breakdown + action

Layer 1 baseline · Mrs. C **96 / 100**

Fall history	**+23**	recent injurious
Conditions (at cap)	**+22**	cognitive · vision · interaction
Medications	**+18**	opioid + benzo + sedative + poly
Sensory / physiologic	**+13**	med side-effects + orthostatic
Mobility	**+12**	walker + unsteady
Mood	**+8**	worry often

Recommended action: review gabapentin dose with prescriber. Outreach queued.

BUILDING FOR LATER

Today's score is transparent. Tomorrow's model is trained.

Every fall event the band detects becomes a labeled outcome. The same architecture supports a future ML model — when we have enough outcome data, the weighted sum becomes trained coefficients.

v1 — TODAY
Transparent additive composite

- Literature-OR-derived weights
- STEADI screen as backbone
- 4 worked vignettes
- Cohort-calibrated medication tier
- Wellness-lane discipline locked

v2 — PILOT
Outcome data collection

- 6–12 months prospective fall diaries
- Every detected fall labeled
- Validates current weights
- Identifies which interactions matter
- Refines per-input weights

v3 — POST-PILOT
Trained ML model

- Same inputs, learned coefficients
- Computes individual fall probability
- Accuracy (AUC) tested head-to-head vs STEADI
- Quarterly re-trains on new data
- Genuinely most accurate predictor

The architecture doesn't change between v1 and v3 — only the math behind each weight. v1 produces what v3 will validate.

OPEN DECISIONS

Decisions to lock to finalize v0.6 of the spec

Six asks. Five clinical / one strategic. None are weights themselves — those follow the science. These are the structural calls.

☐	**ENDORSE** Two-layer architecture (baseline + live monitoring)	*Clinical lead*
☐	**ENDORSE** 5 STEADI-derived Layer 1 additions (fall history, mobility aid, worry, urinary, depression)	*Clinical lead*
☐	**CONFIRM** Diminishing returns within medication classes (Park 2015 / Beunza 2018 curves)	*Clinical lead*
☐	**CONFIRM** Two interaction bonuses (orthostatic × antihypertensive; cognitive × polypharmacy)	*Clinical lead*
☐	**CONFIRM** Category caps (fall history 30 · medications 22 · conditions 22 · mobility 18 · sensory 14 · mood 10)	*Clinical + pharmacy ops*
☐	**LOCK** Wellness-lane wording — band card states + clinical-view detail (see slide 9)	*Legal + clinical*

Lock these six and the v0.6 spec writes itself this week. Sandbox stays live for sensitivity testing in advanced mode.