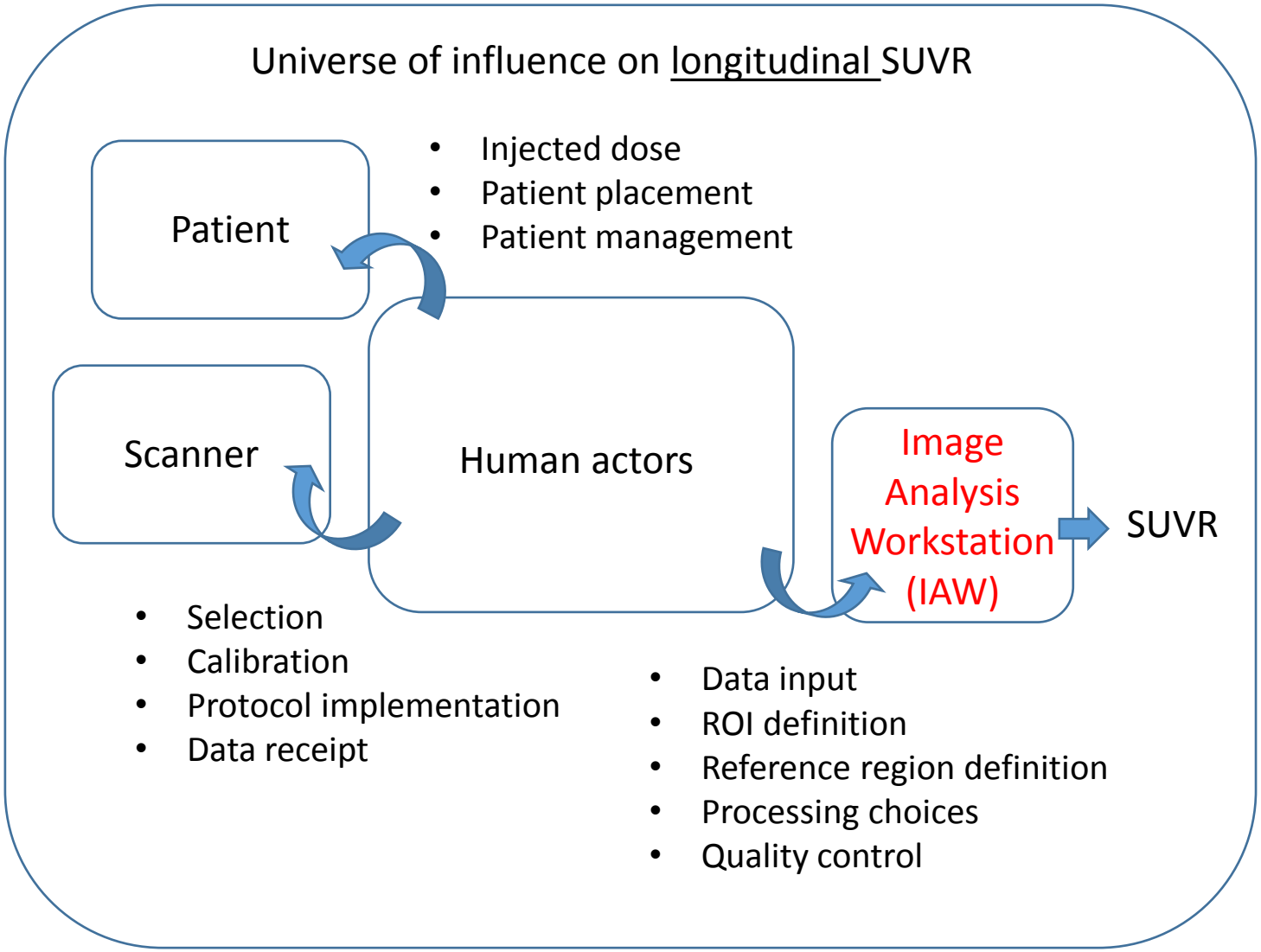
QIBA PET Amyloid Claim 1

A measured change in SUVR of Δ % indicates that a true change has occurred if $\Delta > 8\%$, with 95% confidence.



Key Points

- Unknown how each component contributes to overall system variance
- We are focusing only on IAW for this section of conformance testing

QIBA PET Amyloid Image Analysis Workstation Needs Based on Claim

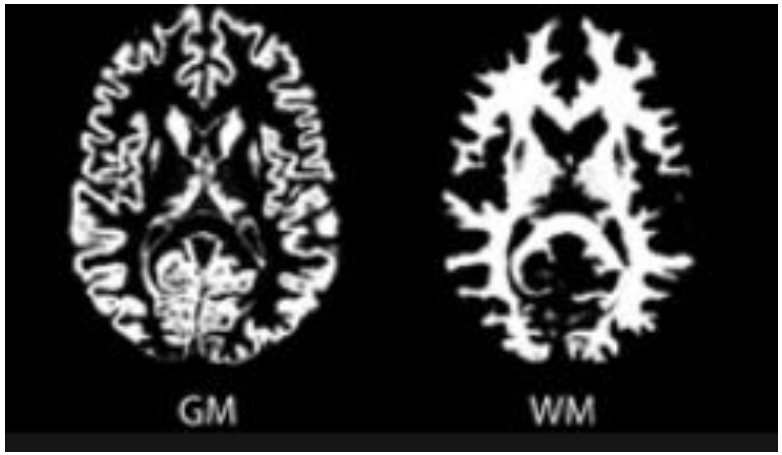
- Only have longitudinal claim
  - No need to measure bias, as long as:
    - Same patient, same scanner, same protocol, same analysis, etc.
    - Note: major offsets or constant error still unacceptable and detected by linearity tests (under what conditions)
  - Linearity
    - Is our system linear for a range of SUVRs?
  - Repeatability
    - Can we get the same SUVR multiple times if nothing has changed?

Major Objectives of IAW Conformance

- Test Linearity
  - Will simulate 6 different subjects
- Test Repeatability
  - Will simulate 5 different acquisitions per subject
- “DRO” is therefore a series of 30 different images
- DRO series derived from a single MRI segmentation
  - Therefore we will NOT be testing different brain morphologies
  - Time constraints don’t allow more

DRO Series – Simulation of 6 Different Subjects

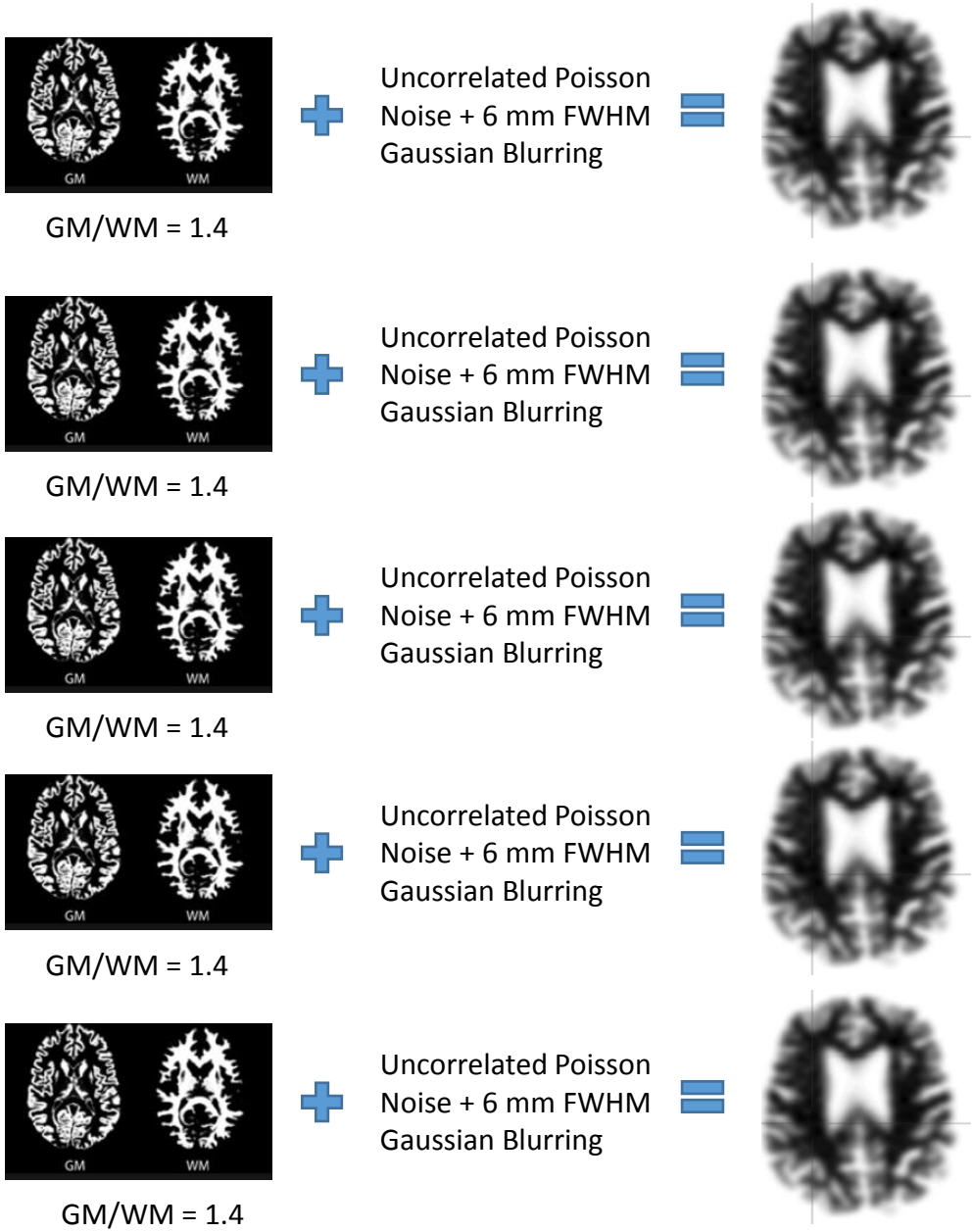
- Subject 1
  - GM/WM = 0.9
- Subject 2
  - GM/WM = 1.0
- Subject 3
  - GM/WM = 1.1
- Subject 4
  - GM/WM = 1.2
- Subject 5
  - GM/WM = 1.3
- Subject 6
  - GM/WM = 1.4



Segmented DRO - values of GM and WM can be varied

DRO Series – Simulation of 5 Different Acquisitions on Same Subject

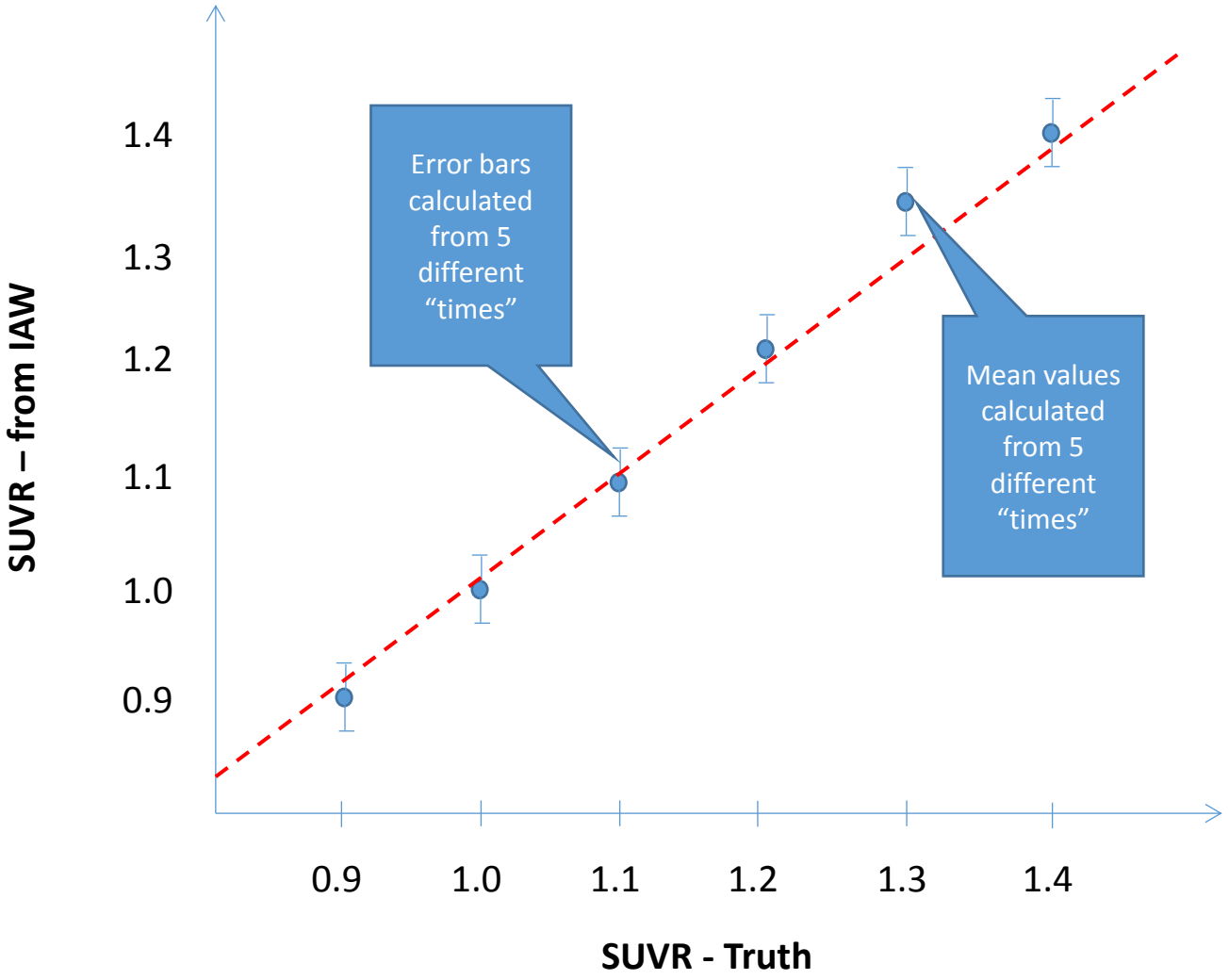
- Subject 6
  - Generate 5 different images by randomly adding clinical-type noise



Example Output – For Single Target Region

Will be one graph for each Target Region if single reference region is used
If multiple reference regions, then total graphs = (number of target regions) x (number of reference regions)

IAW Conformance – Target Region 1



Key Points

- Linearity: Profile will state accepted linearity measures (e.g. quadratic term, slope, R^2, etc.)
- Repeatability: Profile will state acceptable error bars for data points

Typical Regions Used for Target and Reference

Target

- Frontal
- Anterior cingulate
- Posterior cingulate
- Lateral temporal
- Inferior parietal regions
- Occipital cortex

Reference

- Whole cerebellum
- Cerebellar gray matter
- Pons
- Brainstem
- Eroded subcortical white matter
- Composite

Specify regions that are GM only for this conformance test?

Need to report region mask that were used for target and reference regions by the IAW?

The Profile would tell the IAW actor to:

1. Fit an ordinary least squares (OLS) regression of the Y_i's on X_i's (blue data points on previous graph). A quadratic term is first included in the model: $Y = \beta_0 + \beta_1 X + \beta_2 X^2$.
2. Re-fit a linear model: $Y = \beta_0 + \beta_1 X$ (red dotted line on previous graph). R-squared (R^2) shall be >0.90.
3. The estimate of β_1 and of B_2 shall be reported as part of the assessment record. – see Compliance Statistics Template

4. At each measurand (e.g. SUVR) value, calculate the mean and SD.
5. Calculate the %RC (formula).
6. The %RC shall be ≤4%.

Sample Size Considerations for Testing RC:

Assumption (due to our Claim): The IAW's RC needs to be ≤4%.

- With 6 SUVR values ("subjects"), and 5 realizations ("times") at each, an actor would need to have their RC<2.6% in order to meet the Profile criterion (80% power to show that their RC is ≤4%)

Options:

# of Subjects (SUVRs)	# of Realizations (Tests per subject)	RC Threshold
6	5	2.6%
7	5	2.8%
9	5	2.9%
11	5	3.0%
6	10	3.1%

Profile: Next Steps and Milestones

- Have current version of DRO read by radiologist (UW and Rathan)
- Make requested changes to DRO based on radiologist feedback
- Constrain what DRO tests in optimal way
  - Single Gaussian filter value for smoothing? (currently set at 6 mm FWHM)
  - Only one patient morphology will be tested (no time to segment another MRI volume)
  - Decide if anatomical regions will be specified
  - Decide if region boundaries will be specified
  - Decide if test needs to report an overlay of the target and reference regions on the DRO
  - MRI will be provided with the DRO series
  - Should multiple realizations include simulation of patient movement?
- Develop limited initial series of DROs and test on IAWs
- Based on feedback, updatee DRO series and Profile IAW Conformance section of Profile