

Global Biometrics & data Sciences

AI-Assisted Metadata Programming: A Transparent Framework for PCS in Lab Data Analysis

Donghua Zeng, Taniya Muliylil

SM08

1. The Reality Today (SAP → Manual Code)

Clinical Laboratory Variables	Units	Low MA Criterion	High MA Criterion
		< 0.9 x LLN, or	1.1 x ULN, or
Potassium, Serum	mmol/L	if pre-dose < LLN then use < 0.9 x pre-dose	if pre-dose < LLN then use > ULN
		if pre-dose > ULN then use < LLN	if pre-dose > ULN then use > 1.1 x pre-dose

Cropped SAP SPEC except (human-readable rules)

- ❖ Accurate but slow, error-prone, hard to audit.
- ❖ Every change in SAP → recoding.
- ❖ Good programmers spend time translating prose, not analyzing data.

❑ Example study: 28 analytes, total 77 criteria

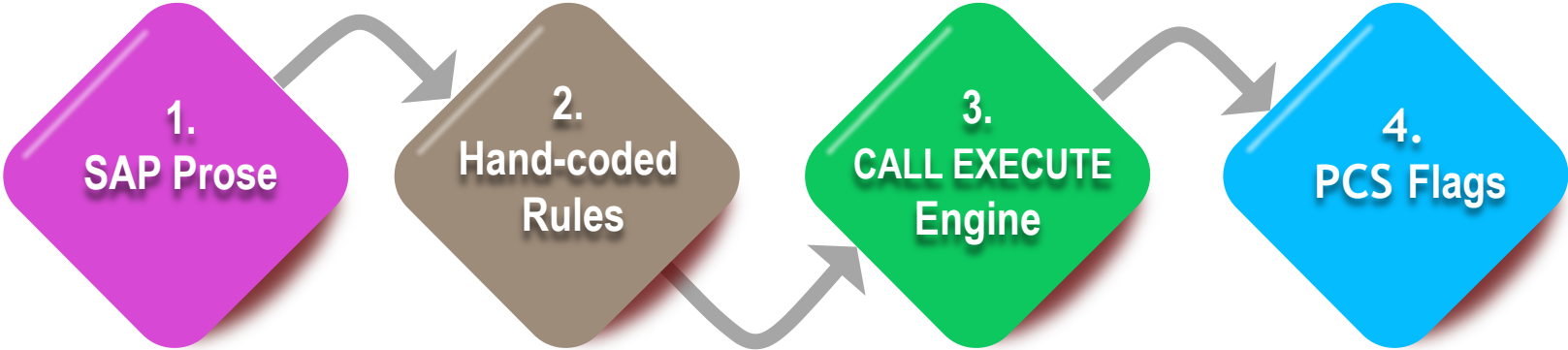
```

217 *** POTASSIUM(K) low ***;
218 %let KLOW = %str("< 0.9 x LLN, or if pre-dose < LLN then use < 0.9 x pre-dose if pre-dose > ULN then use < LLN");
219 if ANRLO > .Z then do;
220 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL =%str(< 0.9*ANRLO), AH=N, PCSL= &KLOW., PCSH=);
221 end;
222 if .Z < Base < ANRLO and PCSLCR = "N" then do;
223 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL =%str(< 0.9*BASE), AH=N, PCSL= &KLOW., PCSH=);
224 end;
225 if Base > ANRHI > .Z and ANRLO > .Z and PCSLCR = "N" then do;
226 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL = %str(< ANRLO), AH=N, PCSL= &KLOW., PCSH=);
227 end;
228 if ANRLO > .Z and PCSLCR = "" then do;
229 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL = %str( ne AVAL), AH=N, PCSL= &KLOW., PCSH=);
230 end;
231
232 *** POTASSIUM(K) High ***;
233 %let KHIGH = %str("> 1.1 x ULN, or if pre-dose < LLN then use > ULN if pre-dose > ULN then use > 1.1 x pre-dose");
234 if ANRHI > .Z then do;
235 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL = N, AH=%str(> 1.1*ANRHI), PCSL= , PCSH= &KHIGH., SKIPAL = Y);
236 end;
237 if .Z < Base < ANRLO and ANRHI > .Z and PCSHCR = "N" then do;
238 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL = N, AH=%str(> ANRHI), PCSL= , PCSH= &KHIGH., SKIPAL = Y);
239 end;
240 if Base > ANRHI > .Z and PCSHCR = "N" then do;
241 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL = N, AH=%str(> 1.1*Base), PCSL= , PCSH= &KHIGH., SKIPAL = Y);
242 end;
243 if ANRHI > .Z and PCSHCR = "" then do;
244 %PCS(PARCAT3= CHEMISTRY, PARAMCD= K, AL = N, AH=%str( ne AVAL), PCSL= , PCSH= &KHIGH., SKIPAL = Y);
245 end;
246
247

```

Tedious SAS code block implementing one analyte's PCS criteria

2. CALL EXECUTE Improves Reuse—but the Inputs Stay Manual



A	B	C	D	E	F
PARAMCD	PCSSEQ	DIREC	PRECOND	CRITERIA	PCSDESCi
<input PARAMCD>	<input PCSSEQ Sequential>	<input PCS DIREC Direction, e.g. H, >	<criteria pre-condition in SAS phrase fragment>	<criteria SAS phrase fragment>	<optional individual criteria text>

A blank metadata table (xlsx)

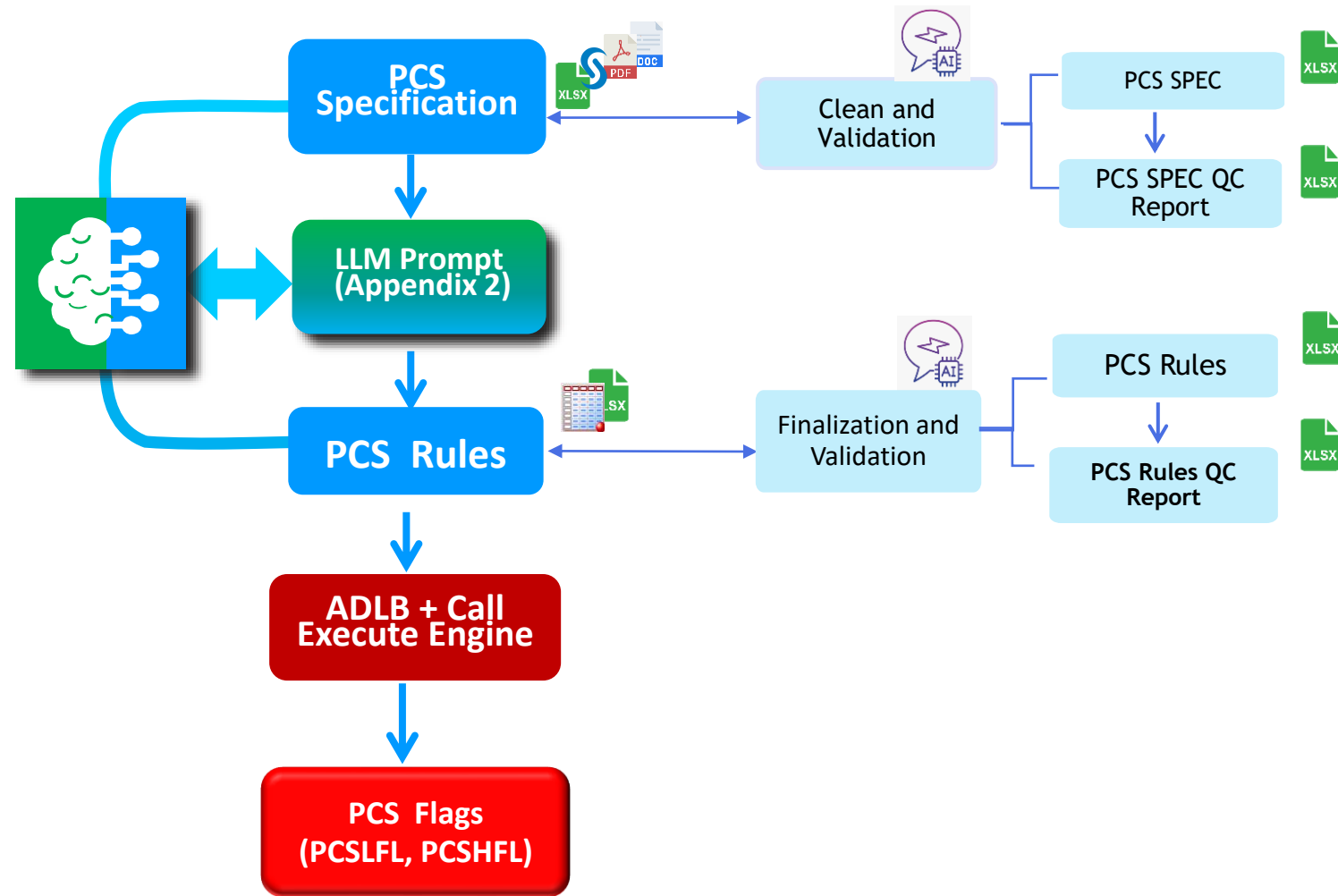
❑ Each criteria change still rewrites code strings..

❑ A metadata table of Criteria as a lookup table

```
29 data _null_;
30   set pcs_rules end = eof;
31   if _n_ = 1 then do;
32     call execute('data adlb_1;');
33     call execute('  set adlb;');
34     call execute('  length _PCSLFL_ _PCSHFL_ $50 PCSLFL PCSHFL $1 PCSLCR PCSHCR $200 ;');
35     call execute('  _PCSLFL_ = ""; _PCSHFL_ = ""; ');
36   end;
37   call execute('  if strip(PARAMCD) = "||strip(PARAMCD)||" then do;'); /*CD*/
```

SAS Call Execute Engine (part of code)

3. The Pivot: LLM to Covert PCS SPEC to SAS Executable Codes



4. AI Prompt → PCS SPEC → PCS Rules (Structured SAS Logic)

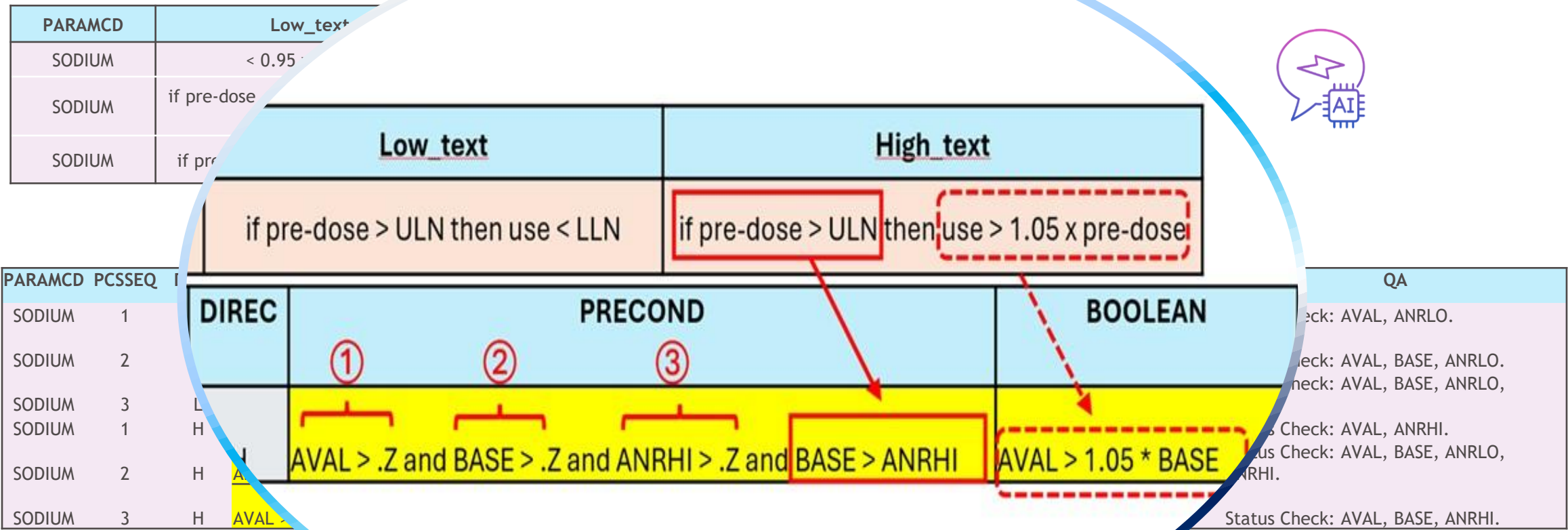
PARAMCD	Low_text	High_text
SODIUM	< 0.95 x LLN, or	> 1.05 x ULN, or
SODIUM	if pre-dose < LLN then use < 0.95 x pre-dose;	if pre-dose < LLN then use > ULN;
SODIUM	if pre-dose > ULN then use < LLN	if pre-dose > ULN then use > 1.05 x pre-dose

- ❑ PCS SPEC
- ❑ AI Prompt
- ❑ AI Output: PCS Rules



PARAMCD	PCSSEQ	DIREC	PRECOND	BOOLEAN	PCSDISC	QA
SODIUM	1	L	AVAL > .Z and ANRLO > .Z	AVAL < 0.95 * ANRLO	< 0.95 x LLN, or if pre-dose < LLN then use < 0.95 x pre-dose;	Status Check: AVAL, ANRLO.
SODIUM	2	L	AVAL > .Z and BASE > .Z and ANRLO > .Z and BASE < ANRLO AVAL > .Z and BASE > .Z and ANRLO > .Z and ANRHI > .Z and BASE > ANRHI	AVAL < 0.95 * BASE AVAL < ANRLO	if pre-dose > ULN then use < LLN	Status Check: AVAL, BASE, ANRLO. Status Check: AVAL, BASE, ANRLO, ANRHI.
SODIUM	3	L	AVAL > .Z and ANRHI > .Z	AVAL > 1.05 * ANRHI	> 1.05 x ULN, or	Status Check: AVAL, ANRHI.
SODIUM	1	H	AVAL > .Z and BASE > .Z and ANRLO > .Z and BASE < ANRLO and ANRHI > .Z	AVAL > ANRHI	if pre-dose < LLN then use > ULN; if pre-dose > ULN then use > 1.05 x pre-dose	Status Check: AVAL, BASE, ANRLO, ANRHI.
SODIUM	2	H	AVAL > .Z and BASE > .Z and ANRHI > .Z and BASE > ANRHI	AVAL > 1.05 * BASE		Status Check: AVAL, BASE, ANRHI.

4.1 AI Prompt → Parse SPEC to SAS Expression (PCS Rules)



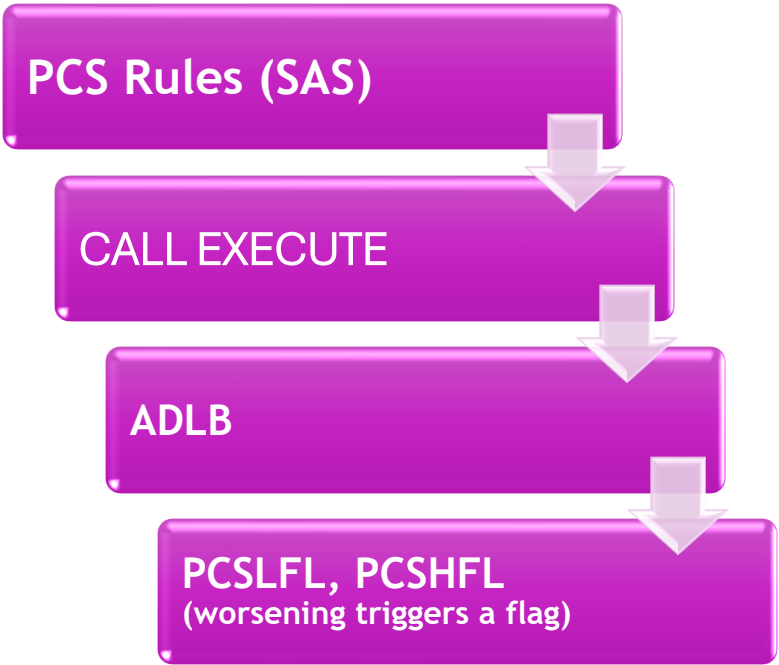
5. ADLB + CALL EXECUTE = PCS Flags (Programmatic)

Low Direction

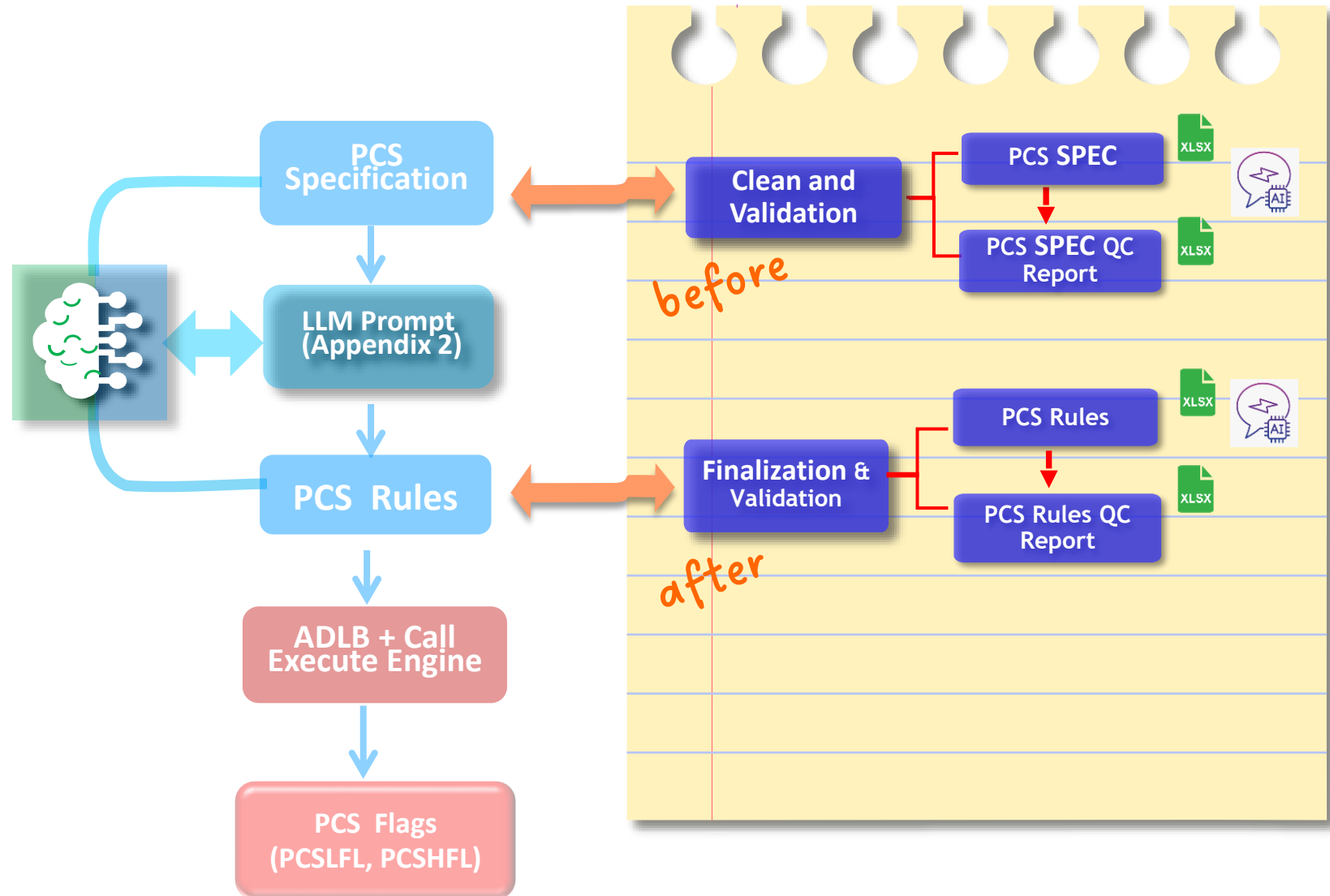
Obs	SUBJID	PARAMCD	VISIT	AVAL	BASE	ANRLO	ANRHI	_PCSLY_	_PCSLN_	PCSLFL
1	101	WBC	visit1	18.0	2.9	3	10		N2 N1	N
2	101	WBC	visit2	2.3	2.9	3	10	Y2	N1	Y
3	101	WBC	visit3	1.8	2.9	3	10	Y2 Y1		Y
4	103	SODIUM	visit1	132.0	.	135	145		N1	N
5	104	SODIUM	visit1	90.0	.	135	145	Y1		Y

High Direction

Obs	SUBJID	PARAMCD	VISIT	AVAL	BASE	ANRLO	ANRHI	_PCSHY_	_PCSHN_	PCSHFL
1	101	WBC	visit1	18	2.9	3	10	Y2 Y1		Y
2	101	WBC	visit2	2.3	2.9	3	10		N2 N1	N
3	101	WBC	visit3	1.8	2.9	3	10		N2 N1	N
4	103	SODIUM	visit1	132	.	135	145		N1	N
5	104	SODIUM	visit1	90	.	135	145		N1	N



6. Guardrails: QC by AI Execution + Human



6.1 Guardrails: QC by AI Execution + Human

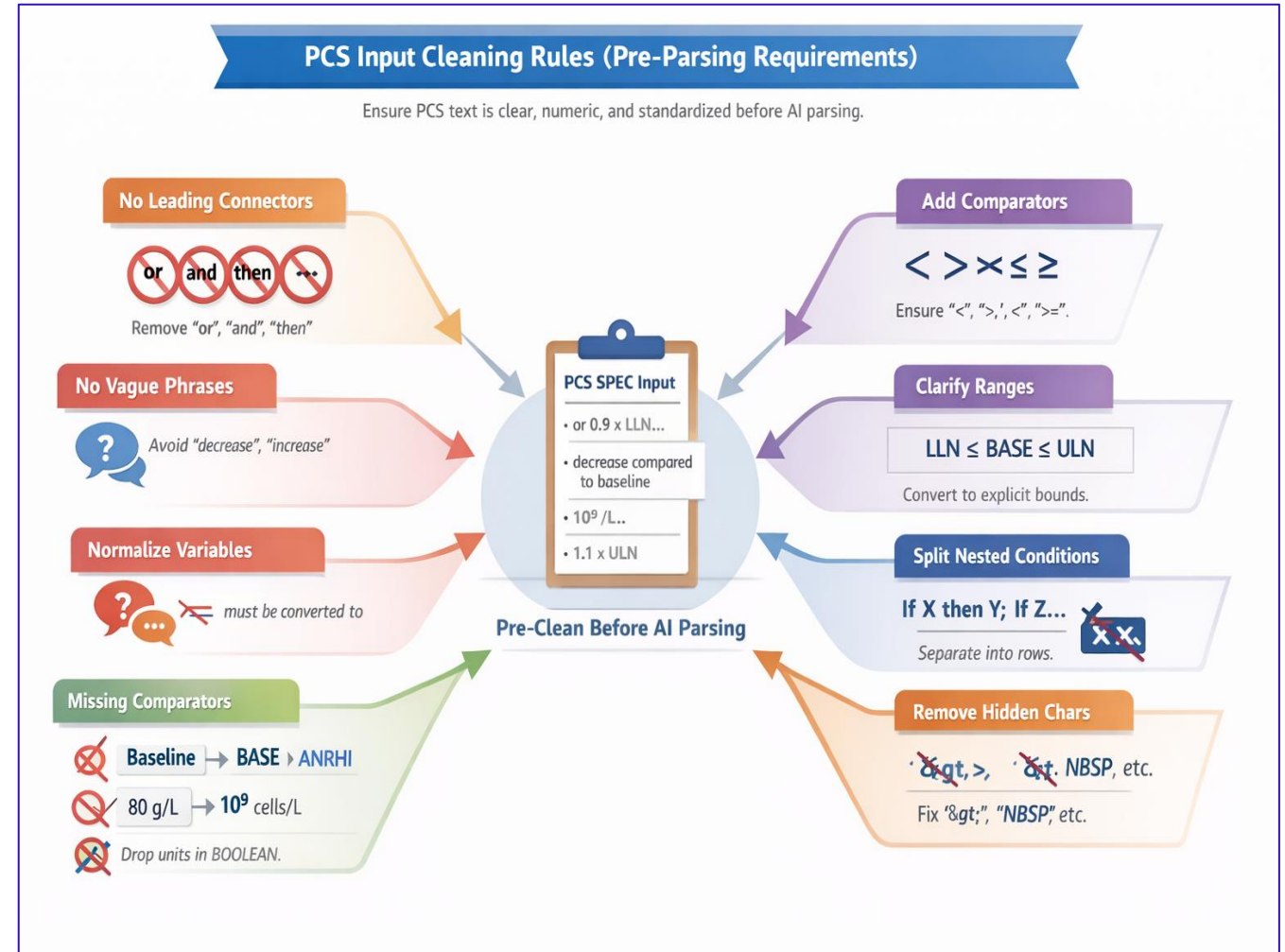
A silent failure

1) When a programmer sees

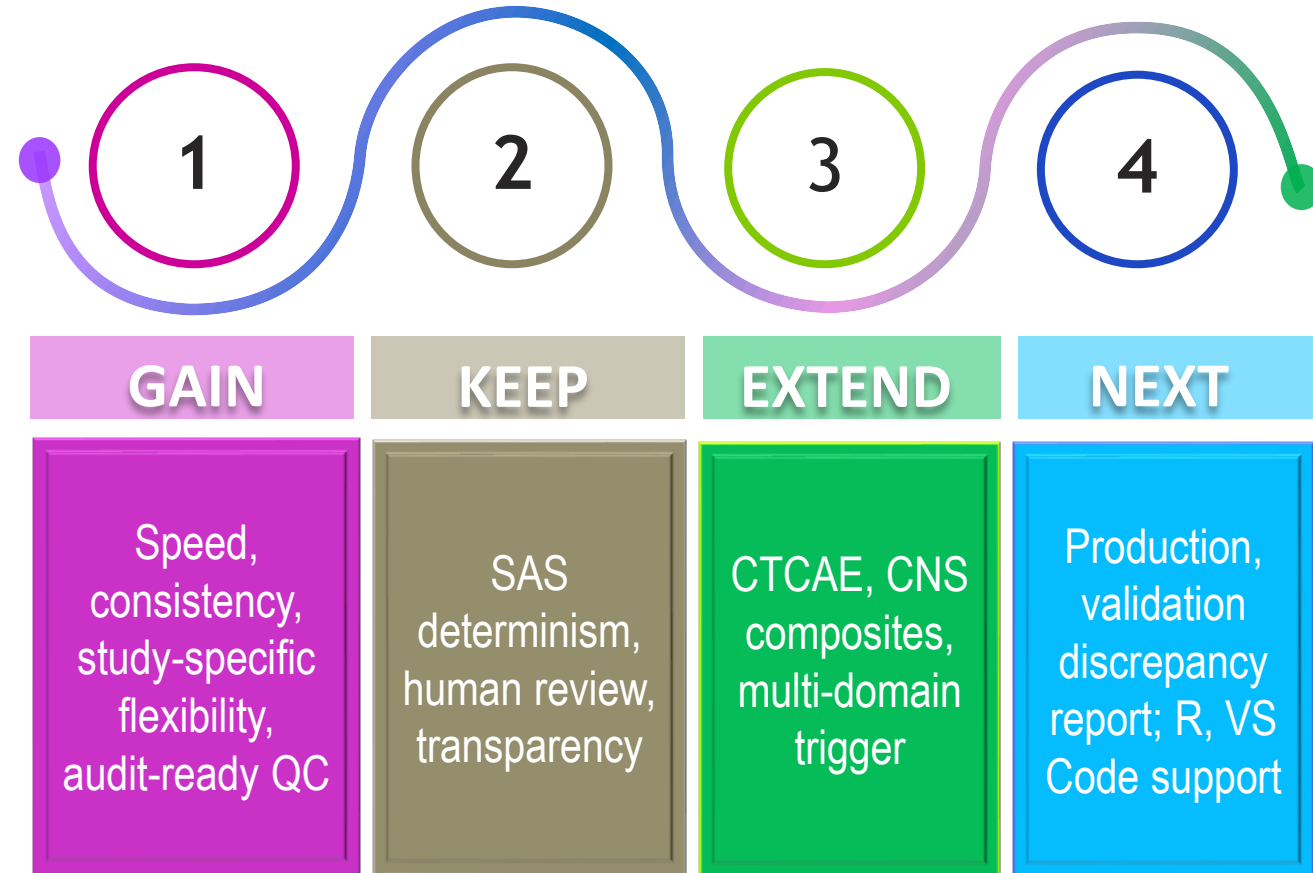
```
if AVAL > ANRHI then PCS=1
```

2) What may actually be passed to SAS

```
if AVAL > ANRHI then PCS=1
```



7. What we gain (and keep)



8. What we have learned

Fault-Tolerance Design

Human ↔ human

□ A word

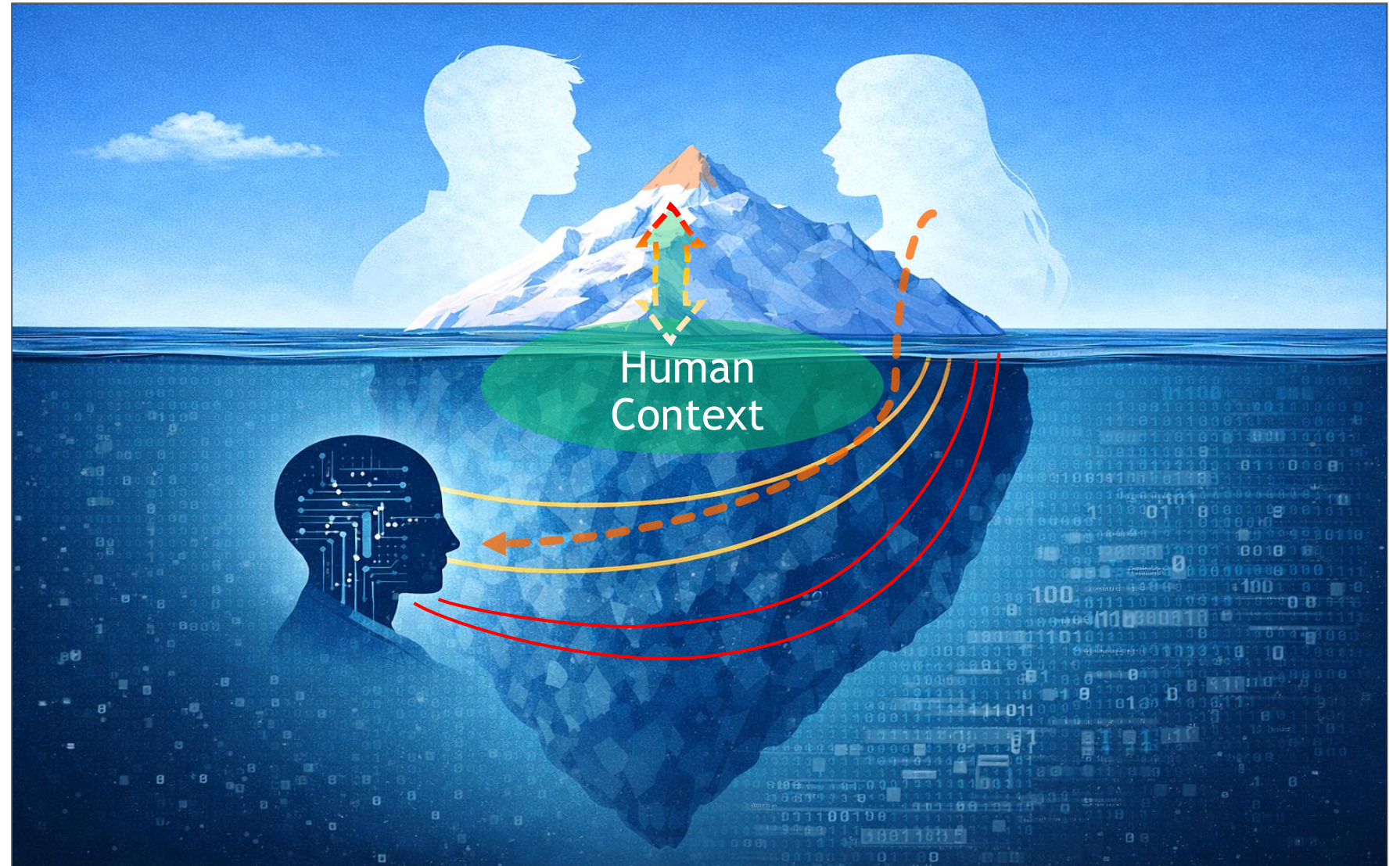
□ A hint

□ A glance

□ *Underwater Context*

Human ↔ AI

Make the Invisible Explicit



9. What we must do

- **Generation**
- **Validation**
- **Governance**



Acknowledgment

Neuroscience Teams

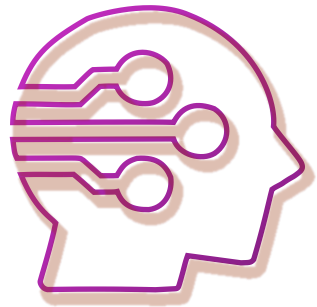
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PHUSE Faculty and Members

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Contact Information



Author Name: Donghua Zeng

Company: Bristol Myers Squibb, USA

Company Address: 3551 Lawrenceville Rd., Princeton, NJ 08540 USA

Email: donghua.zeng@bms.com

Author Name: Taniya Muliylil

Company: Bristol Myers Squibb, USA

Company Address: 3551 Lawrenceville Rd., Princeton, NJ 08540 USA

Email: taniya.muliylil@bms.com

