

# **WPP, Worst Programming Practice**

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## **Real life pitfalls in every day clinical programming; why and how you should avoid them**

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# Agenda

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- Efficiency pitfalls
- Programming pitfalls
- Macro pitfalls
- Comments, code development and excellent programming

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## PITFALL

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- EFFICIENCY PITFALL 1: IF INSTEAD OF WHERE

```
data TEMP1;  
    set SDTM.LB;  
    if LBCAT = 'HEMATOLOGY';  
run;
```

## SOLUTION 😊

- EFFICIENCY PITFALL 1: IF INSTEAD OF WHERE

```
data TEMP1;  
    set SDTM.LB;  
    if LBCAT = 'HEMATOLOGY';  
run;
```



```
data TEMP1;  
    set SDTM.LB (where = (LBCAT = 'HEMATOLOGY'));  
run;
```

## PITFALL

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- EFFICIENCY PITFALL 2: COPYING DATA WITH DATA STEP

```
/* Get the SDTM data sets */  
data DM;  
    set SDTM.DM;  
run;  
data LB;  
    set SDTM.LB;  
run;  
data XP;  
    set SDTM.XP;  
run;
```

## SOLUTION 😊

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- EFFICIENCY PITFALL 2: COPYING DATA WITH DATA STEP

```
/* Get the SDTM data sets */  
proc datasets memtype=data;  
    copy in=SDTM out=WORK;  
    select DM LB XP;  
quit;
```

OR

```
/* Get the SDTM data sets */  
proc copy in=SDTM out=WORK memtype=data;  
    select DM LB XP;  
run;
```

## PITFALL

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- **EFFICIENCY PITFALL 3: CONCATENATING DATA WITH DATA STEP**

```
/* Final step, create one data set */  
data ADAM.ADVS;  
    set VS_PARAM1  
        VS_PARAM2  
    ;  
run;
```

## SOLUTION 😊

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- EFFICIENCY PITFALL 3: CONCATENATING DATA WITH DATA STEP

```
proc append base=VS_PARAM1 data=VS_PARAM2;  
run;
```

OR

```
proc datasets;  
    append base=VS_PARAM1 data=VS_PARAM2;  
quit;
```

## PITFALL

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- EFFICIENCY PITFALL 4: CHANGING METADATA WITH DATA STEP

```
/* Change some metadata in ADLB */  
data ADLB;  
    set ADLB;  
    format AVISITN ZAVIS.;  
    label AVISITN='Analysis Visit';  
    rename TEMPSEQ=LBSEQ;  
run;
```

## SOLUTION 😊

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- EFFICIENCY PITFALL 4: CHANGING METADATA WITH DATA STEP

```
/* Change some metadata in ADLB */  
proc datasets lib=work nolist;  
    modify ADLB;  
        format AVISITN ZAVIS.;  
        label AVISITN='Analysis Visit';  
        rename TEMPSEQ=LBSEQ;  
    run;  
quit;
```

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## PITFALL

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- PROGRAMMING PITFALL 1: VARIABLE GONE MISSING

ERROR: Variable NAME is not on file SASHELP.CLASS.

### EXAMPLE CODE THAT CAUSES THIS ERROR

```
data class;  
    set sashelp.class (keep=age height weight where=(name =: 'J'));  
run;
```

# PITFALL

## • PROGRAMMING PITFALL 2: OVERWRITE VARIABLES WITH MERGE

### BLD\_1

|   | 123 | subjdn | ⚠ | type | 123 | vol |
|---|-----|--------|---|------|-----|-----|
| 1 |     | 10004  |   | A    |     | 19  |
| 2 |     | 12001  |   | O    |     | 43  |
| 3 |     | 12001  |   | O    |     | 38  |
| 4 |     | 12001  |   | O    |     | 54  |

```
data bld;
  merge bld_1 (in=a) bld_2;
  by subjdn;
  if a;
run;
```

### BLD\_2

|   | 123 | subjdn | 123 | code | 123 | vol |
|---|-----|--------|-----|------|-----|-----|
| 1 |     | 10004  |     | 61   |     | 9   |
| 2 |     | 10011  |     | 65   |     | 25  |
| 3 |     | 12001  |     | 63   |     | 36  |
| 4 |     | 12002  |     | 63   |     | 21  |

### BLD

|   | 123 | subjdn | ⚠ | type | 123 | vol | 123 | code |
|---|-----|--------|---|------|-----|-----|-----|------|
| 1 |     | 10004  |   | A    |     | 9   |     | 61   |
| 2 |     | 12001  |   | O    |     | 36  |     | 63   |
| 3 |     | 12001  |   | O    |     | 38  |     | 63   |
| 4 |     | 12001  |   | O    |     | 54  |     | 63   |

## SOLUTION 😊

- PROGRAMMING PITFALL 2: OVERWRITE VARIABLES WITH MERGE

```
data bld;  
  merge bld_1 (in=a) bld_2 (keep=subjidn code);  
  by subjidn;  
  if a;  
  
run;
```

|   | subjidn | type | vol | code |
|---|---------|------|-----|------|
| 1 | 10004   | A    | 19  | 61   |
| 2 | 12001   | O    | 43  | 63   |
| 3 | 12001   | O    | 38  | 63   |
| 4 | 12001   | O    | 54  | 63   |

- In the right-hand data set, aim to keep only the BY-variables and the new variables you wish to merge on to the left-hand data set
- Make sure `OPTION MSGLEVEL=I` is used (this is not the SAS default)!

# PITFALL

- PROGRAMMING PITFALL 3: WRONG DATA CARRIED FORWARD ON MERGE

DATA SET 1 (VS)

|    |  USUBJID |  VSTESTCD |  VSSTRESN |
|----|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| 1  | 001-651877                                                                                | SYS                                                                                        | 120                                                                                          |
| 2  | 001-651879                                                                                | SYS                                                                                        | 151                                                                                          |
| 3  | 001-651879                                                                                | SYS                                                                                        | 121                                                                                          |
| 4  | 001-651898                                                                                | SYS                                                                                        | 139                                                                                          |
| 5  | 001-651898                                                                                | SYS                                                                                        | 134                                                                                          |
| 6  | 001-651898                                                                                | SYS                                                                                        | 127                                                                                          |
| 7  | 001-651898                                                                                | SYS                                                                                        | 129                                                                                          |
| 8  | 001-651899                                                                                | SYS                                                                                        | 131                                                                                          |
| 9  | 001-651899                                                                                | SYS                                                                                        | 141                                                                                          |
| 10 | 001-651901                                                                                | SYS                                                                                        | 153                                                                                          |

DATA SET 2 (DM)

|   |  USUBJID |  AGE |  ARMCD |  HIGH_FLAG |
|---|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 1 | 001-651877                                                                                  | 52                                                                                      | DRUG A                                                                                      |                                                                                                 |
| 2 | 001-651879                                                                                  | 31                                                                                      | DRUG B                                                                                      |                                                                                                 |
| 3 | 001-651898                                                                                  | 33                                                                                      | DRUG A                                                                                      |                                                                                                 |
| 4 | 001-651899                                                                                  | 40                                                                                      | DRUG B                                                                                      |                                                                                                 |
| 5 | 001-651901                                                                                  | 61                                                                                      | DRUG B                                                                                      |                                                                                                 |

## PITFALL

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- PROGRAMMING PITFALL 3: WRONG DATA CARRIED FORWARD ON MERGE

### THE CODE

```
data ADVS1;  
    merge VS DM;  
    by USUBJID;  
    if VSSTRESN >= 135 then high_flag = 'Y';  
run;
```

# PITFALL

- PROGRAMMING PITFALL 3: WRONG DATA CARRIED FORWARD ON MERGE

## THE RESULT

|    |  USUBJID |  VSTESTCD |  VSSTRESN |  AGE |  ARMCD |  HIGH_FLAG |
|----|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 1  | 001-651877                                                                                | SYS                                                                                        | 120                                                                                        | 52                                                                                      | DRUG A                                                                                    |                                                                                               |
| 2  | 001-651879                                                                                | SYS                                                                                        | 151                                                                                        | 31                                                                                      | DRUG B                                                                                    | Y                                                                                             |
| 3  | 001-651879                                                                                | SYS                                                                                        | 121                                                                                        | 31                                                                                      | DRUG B                                                                                    | Y                                                                                             |
| 4  | 001-651898                                                                                | SYS                                                                                        | 139                                                                                        | 33                                                                                      | DRUG A                                                                                    | Y                                                                                             |
| 5  | 001-651898                                                                                | SYS                                                                                        | 134                                                                                        | 33                                                                                      | DRUG A                                                                                    | Y                                                                                             |
| 6  | 001-651898                                                                                | SYS                                                                                        | 127                                                                                        | 33                                                                                      | DRUG A                                                                                    | Y                                                                                             |
| 7  | 001-651898                                                                                | SYS                                                                                        | 129                                                                                        | 33                                                                                      | DRUG A                                                                                    | Y                                                                                             |
| 8  | 001-651899                                                                                | SYS                                                                                        | 131                                                                                        | 40                                                                                      | DRUG B                                                                                    |                                                                                               |
| 9  | 001-651899                                                                                | SYS                                                                                        | 141                                                                                        | 40                                                                                      | DRUG B                                                                                    | Y                                                                                             |
| 10 | 001-651901                                                                                | SYS                                                                                        | 153                                                                                        | 61                                                                                      | DRUG B                                                                                    | Y                                                                                             |

## SOLUTION 😊

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- PROGRAMMING PITFALL 3: WRONG DATA CARRIED FORWARD ON MERGE

```
data ADVS1;  
  merge VS DM (drop=high_flag);  
  by USUBJID;  
  if VSSTRESN >= 135 then high_flag = 'Y';  
run;|
```

## PITFALL

- PROGRAMMING PITFALL 4: TRANSPOSE WITHOUT ID

### ORIGINAL DATASET

|  VISIT |  USUBJID |  XPORRES |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1                                                                                       | 1001                                                                                      | 5                                                                                         |
| 3                                                                                       | 1001                                                                                      | 5                                                                                         |
| 4                                                                                       | 1001                                                                                      | .                                                                                         |
| 5                                                                                       | 1001                                                                                      | 9                                                                                         |
| 1                                                                                       | 1002                                                                                      | 5                                                                                         |
| 3                                                                                       | 1002                                                                                      | 6                                                                                         |
| 4                                                                                       | 1002                                                                                      | .                                                                                         |
| 5                                                                                       | 1002                                                                                      | 5                                                                                         |

### THE CODE

```
proc transpose data = RAW.PICCO out = TR_PICCO (drop = _NAME_)
  prefix = VISIT;
  by USUBJID;
  var XPORRES;
run;
```

## PITFALL

- PROGRAMMING PITFALL 4: TRANSPOSE WITHOUT ID

### RESULT

|  USUBJID |  visit1 |  visit2 |  visit3 |  visit4 |
|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 1001                                                                                      | 5                                                                                        | 5                                                                                        | .                                                                                        | 9                                                                                          |
| 1002                                                                                      | 5                                                                                        | 6                                                                                        | .                                                                                        | 5                                                                                          |

## SOLUTION 😊

- PROGRAMMING PITFALL 4: TRANSPOSE WITHOUT ID

```
proc transpose data=RAW.PICCO out=TR_PICCO (drop=_name_)  
  prefix = VISIT;  
  by PT;  
  var RESULT;  
  ID VISIT;  
run;
```

|  USUBJID |  VISIT1 |  VISIT3 |  VISIT4 |  VISIT5 |
|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| 1001                                                                                      | 5                                                                                        | 5                                                                                        | .                                                                                          | 9                                                                                          |
| 1002                                                                                      | 5                                                                                        | 6                                                                                        | .                                                                                          | 5                                                                                          |

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## PITFALL



- MACRO PITFALL 1: THE NESTED MACRO DEFINITION

```
%macro first;  
  
    %macro second(param=);  
  
        proc sort data=vs  
            (where=(vstestcd = "&param"))  
            out=vs_temp;  
            by vscat vstestcd;  
        run;  
  
        data vs_temp1;  
            set vs_temp;  
            [Additional manipulations not displayed]  
        run;  
  
        [Additional code not displayed]  
  
    %mend second;  
    %second(param=SYS)  
    %second(param=DIAB)  
    %second(param=TEMPE)  
    %second(param=BMI)  
    %second(param=PO)  
    %second(param=PO2)  
  
    [Additional code not displayed]  
  
%mend first;
```

## SOLUTION 😊

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- MACRO PITFALL 1: THE NESTED MACRO DEFINITION

```
%macro first;

proc sql no print;
    select distinct vstested into
    :param1-:param99
    from vs;
    select count(distinct vstested) into :no
    from vs;
quit;

%do i = 1 %to &no;

    proc sort data = vs
        (where = (vstested = "&&param&i"))
        out = vs_temp&i;
        by vscat vstested;
    run;

    data vs_temp1_&i;
        set vs_temp&i;
        [Additional manipulations not displayed]
    run;

%end;

%mend first;
```

## PITFALL

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- MACRO PITFALL 2: MACRO VARIABLE SCOPE

```
/* From autoexec.sas */  
%let var1 = 10;  
  
/* Anotherprog.sas */  
%put &var1;  
  
%macro _test;  
  
    %let var1 = PH;  
  
%mend _test;  
  
%_test;  
  
%put &var1;
```

## SOLUTION 😊

---

- **MACRO PITFALL 2: MACRO VARIABLE SCOPE**

**DEFINE GLOBAL VARIABLES AS READ ONLY**

```
%global / readonly var1 = 10;
```

**DEFINE VARIABLES BELONGING TO A CERTAIN MACRO AS LOCAL**

```
%macro get_lbtest;  
  
    %local var1;  
    %let var1 = PH;  
  
%mend get_lbtest;  
  
%get_lbtest;  
  
%put &var1;
```

## PITFALL

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- **MACRO PITFALL 3: CONFUSING THE MACRO LANGUAGE WITH THE DATA STEP**

```
%if &input = "" %then %put "missing";
```

## SOLUTION 😊

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- **MACRO PITFALL 3: CONFUSING THE MACRO LANGUAGE WITH THE DATA STEP**

```
%if %length(&input) = 0 %then %put missing;
```

# Agenda

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## COMMENTS

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### COMMENTS STATING THE OBVIOUS (BAD)

```
/* Read in the DM dataset */
data dm;
    set sdtm.dm (drop = armcd actarmcd r:);
    [Additional manipulations not displayed]
run;

/* Sort the dataset before merge */
proc sort data = dm;
    by usubjid derived_value ;
run;
```

### IMPLICIT COMMENTS (GOOD, BUT EXPLICIT COMMENTS NEEDED FOR COMPLEX CODE)

```
data dm (keep = usubjid siteid derived_value);
    set sdtm.dm (keep = usubjid siteid armcd actarmcd);
    [Additional manipulations not displayed]
run;

proc sort data = dm out = sorted_dm;
    by usubjid derived_value;
run;
```

## DATA FOR DEVELOPING, TESTING AND DEBUGGING

---

### SOME “QUICK AND DIRTY” SOLUTIONS

```
data test_data;  
    set ADLB (where=(SUBJIDN between 10001 and 10050));  
run;
```

```
data test_data;  
    set ADLB (obs=100);  
run;
```

```
data test_data;  
    set ADLB (firstobs=101 obs=200);  
run;
```

```
data test_data;  
    do i = 1 to nobs by 5;  
        set ADLB nobs=nobs point=i;  
        output;  
    end;  
    stop;  
run;
```

## DATA FOR DEVELOPING, TESTING AND DEBUGGING

---

### RANDOMISED SAMPLE USING PROC SURVEYSELECT

```
/* Select 100 observations */  
proc surveyselect data=ADLB out=test_data  
    seed = 1  
    method = SRS  
    sampsize = 100  
    noprint;  
run;
```

```
/* Select 10% of observations */  
proc surveyselect data=ADLB out=test_data  
    seed = 1  
    method = SRS  
    samprate = 0.1  
    noprint;  
run;
```

## DATA FOR DEVELOPING, TESTING AND DEBUGGING

---

### IMPORTANT

IF YOU'RE SAMPLING DATA IN A PROGRAM WHICH IS DESTINED FOR PRODUCTION RUNS YOU M U S T MAKE THIS OBVIOUS! THE BEST WAY IS TO ADD TEMPORARY CODE WHICH WRITES AN ERROR TO THE LOG:

```
%put %str(ERROR: DATA SAMPLING IN EFFECT!;  
%put %str(ERROR: NOT VALID FOR PRODUCTION RUNS!;
```

## EXCELLENT PROGRAMMING ?

### CODE THAT'S "TOO SMART"

```
proc sql
  create table &table.start as
  select a.*,
         b.p,
         b.t,
         b.trtlbl,
         compba(tranwrd(catt(max(b.pref), strip(scan(b.lbl,2,'('))), '@@', b.trta)) as trtlbl
  from &table.2(drop=trta) a,
      (select *,
         case
           when prxmatch('/\dTT/', trt) then prxchange('s/TOTAL\s*\|+//', -1, trtb)
           else trtb
         end as lbl,
         case
           when prxmatch('/TT/', trt) then
             prxchange('s/^\s*[^()]+\s*[^()]\$/\s1 Main=@@| \s2/', -1,
                       calculated lbl)
           else ''
         end as pref length=200,
         case
           when prxmatch('/TT/', trt) then 'ALL Main Groups'
           when prxmatch('/PBO/', trt) then 'PBO'
           else 'TREAT'
         end as trta
      from (select *,
              1 as flag,
              prxchange('s/(TRT\d*)(.*)/\s1/', -1, trt) as p,
              prxchange('s/TOT//', -1, trt) as t
            from popu
            where prxmatch('/\d/', trt)
          outer union corr
          select *,
              2 as flag,
              prxchange('s/(TRT\d*)(.*)/\s1/', -1, trt) as p,
              prxchange('s/TT//', -1, trt) as t
            from popu
            where not prxmatch('/\d/', trt)
          )
      ) b
  where a.trtn = b.trtn and
        a.flag = b.flag
  group by a.flag, b.p
;
quit;
```

## EXCELLENT PROGRAMMING !!

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- Be aware of potential pitfalls
- Be pro-active in using the best procedure for the job
- Code for run-time efficiency
- Code for maintenance efficiency

WPP → BPP = 😊

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# That's all folks!

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