#### **Quality Control that Adds Value**

Melinda Ronca-Battista, Northern Arizona University, Chair: AARST/ANSI Radon Measurement Systems Quality Assurance





# Why QA?

Because it SAVES YOU TIME and MONEY QA is required for LEGAL DEFENSIBILITY Allows you to understand the limits of your different measurement systems Without QA, you might as well literally make up numbers





#### Measurement Error

#### Difference From the Truth Bias

- always high or always low
  Systematic—like static electricity on the scale
  JUMP
- Precision Error
  - Sometimes high, sometimes low, Random
  - Some precision error is unavoidable; there will always be
    WIGGLE



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#### QA in Daily Life-Temp

Temperature of your child—school or no school? Mitigate or don't mitigate? Your "quality system" includes storing two thermometers in a kitchen drawer One is an old mercury thermometer, and your 1<sup>st</sup> measurement QC is to shake the mercury down If you didn't, you would get BIAS error



## **Daily Life Bias Check**

- That old thermometer keeps reading high, so put both in your armpit at the same time *to* assess <u>bias</u> error
- The newer thermometer is a better estimate of the truth
- How far from the truth is that old thermometer?What's the difference between them?



#### **Relative Percent Error**

the 2 thermometers are a degree off Is this important? The only way to judge how important is to know how much off from the truth this difference would be Easiest for us to think in proportions, so use % % of the "truth" so put that in the bottom Relative Percent Error!

Difference/NEWthermometer



## **CRM Cross Checks**

(verifying calibration still good, and CRM1 unbiased)

- Between 5-7 months after calibration
- Simultaneous deployment with a CRM2 that was calibrated within the past 12 months but not at the same time as CRM1
- CRM2 is the better estimate of "truth" so the difference is divided by CRM2
- Relative Percent Error = |CRM1-CRM2|/CRM2

just like 2 thermometers under your tongue, when you know one is newer



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#### **CRM Cross Checks** (Verifications)







#### **CRM Cross Checks** (Verifications)

CRM1

ALTHA GUARD



Relative Percent **Error** = |CRM1-CRM2|/CRM2





# Relative Percent **Error** = |CRM1-CRM2|/CRM2





#### What do these RPErrors mean?





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#### Proportions of your RPEs this "far out"





#### **Criteria for CRM Cross Checks**

CRM2	Warning Limit	<b>Control Limit RPE:</b>
concentration:	<b>RPE:</b>	
>=4.0 pCi/L	28%	36%
<4.0 and >=2.0 pCi/L	<b>50%</b>	67%
< 2 pCi/L	n/a	Absolute value of the difference between CRM1 and CRM2 <= 1.0 pCi/L, or both are reported as less than the MDC
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## Back to Temp QC

- Now I have two old thermometers and I don't know which one is better, so I use therm1, and it shows a high temp but my kid's forehead is cool
- I pull out therm2 and put that under her tongue at the same time, and therm1 is half a degree higher than therm2. Is my kid cheating?
- I try it again, and this time they are half a degree off but now therm2 is higher!
- What does this mean?



# 2 Types of Error

#### <u>Bias</u>

always high or always low
 Systematic—like static electricity on the scale
 JUMP (if we didn't shake town mercury therm, and if our CRM built up background and was reading high)
 Precision Error

Sometimes high, sometimes low, Random
Some precision error is unavoidable; there will always be





**CRM Comparison Checks** (assessing imprecision, aka wiggle) Every 10<sup>th</sup> 48-hour measurement Simultaneous deployment of CRM1 and CRM2 If identical including calibration schedule---duplicate Average is the best estimate of "truth" so the difference is divided by their average Relative Percent Difference = **CRM1-CRM2 Average** 

just like 2 thermometers under your tongue, when they're identical



# **CRM Comparison Checks** (duplicates if identical incl calibration schedule)

CRM1

CHARD GUARD





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# **CRM Comparison Checks** (duplicates if identical incl calibration schedule)





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#### Back to Temp QC

Which old therm1 or therm2 is better calibrated?
You can calibrate your own thermometers using the intergalactically recognized natural standards of an ice water bath and boiling water at earth sea level



 We have to use a Standard Test Atmosphere for Radon (STAR) to calibrate methods



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#### Good QA = Common Sense

If it doesn't make sense, it is not good QA!
If you don't log it, it didn't happen.



#### melinda.ronca-battista@nau.edu

