**Supplemental Digital Content 7. Derivation of math formulas.**

Here are the equations for Type I and Type II error probabilities for clinical MBI for the comparison of two means, assuming equal variance and equal group sizes:

(To generalize to unequal group sizes, replace 2 with (r+1)/r and change the degrees of freedom to (r+1)n-2, where r is the ratio of the larger to the smaller group.)

ES = true effect size (difference in means)

n = per group sample size

Type I error (Type I error can only occur when ES<)

Type I error probability = P() +

(1-P()

Type II error (Type II error can only occur when ES)

Type II error probability = P( +

(1- P(

SAS code that implements these equations is available in text file, **Supplemental Digital Content 9**.

**Derivation:**

To be “implementable,” two constraints must be met: a constraint on harm and a constraint on benefit:

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Type I error

When ES<, a decision of “implementable” is a Type I error.

Type I error probability = =

The observed value must be larger than the bigger of the two constraints.

P(harm constraint is bigger) =P

P(harm constraint is bigger)=P(

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P(harm constraint is bigger)=P(

P(benefit constraint is bigger)=1-P(harm constraint is bigger)

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=)

=)

Type I error probability =

) +

)

= P() +

(1-P()

Note: For simplicity, I am ignoring a small dependency between the two probability terms. For example, when the benefit term is bigger at sample sizes below the peak, we know that s2 must be smaller than ; and when the harm term is bigger at sample sizes above the peak, we know that s2 must be bigger than Ignoring this dependency will primarily affect estimates close to the peak (when neither constraint is dominant), and only by a small amount (since s2 will still be close to ).

Type II error

When ES, a failure to find “implementable” is a Type II error.

Type II error probability = =

As before, P(harm constraint is bigger)=P(

P(benefit constraint is bigger)=1-P(harm constraint is bigger)

 =

 =

Type II error probability =P(harm constraint is bigger) +

(1- P(

= P( +

(1- P(