Title: Statistical Computing Methods to Measure Small Intestine Bacterial Overgrowth

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Abstract: Importance: Small Intestine Bacterial Overgrowth (SIBO) occurs due to large numbers of commensal bacteria in the colon. Data shows SIBO is found in children who lack access to clean water and are shorter (decreased length-for-age Z scores since birth). SIBO is associated with disruption of GI motility, impaired micronutrient absorption, and oral vaccination underperformance. Work surrounding the topic involves defining the degree of bacteria overgrowth in developing countries and linking SIBO to measures of growth such as neurocognition and linear growth delay. Benefits of interventions such as antibiotics or nutrients can be studied given proper experimental design requiring substantial duration, subject size, and treatments and are costly. Improved definitions of SIBO can dramatically reduce the costs necessary in carrying out these experiments. SIBO, traditionally diagnosed with hydrogen breath test readings of 12 ppm above baseline, and 5 different SIBO areas under-the-curve (AUC) computations were compared to emphasize different properties of the hydrogen breath test curve. Correlation and linear models were compared between each of the six methods. To compute area-under-curve, numerical integration methods for one-dimensional integrals were used, the methods tested were: 1) Generalized midpoint-rule formula 2) Simpson's rule based upon second-order polynomials 3) Monte-Carlo method for numerical integration 4) the Riemann-Darboux summation 5) trapezium rule. The strongest method with the largest correlation (R= -0.14) between SIBO-AUC and LAZ being Simpson's rule ($p = 0.029$, slope = -0.39). Utilizing a SIBO-AUC, particularly the Simpson method will allow SIBO researchers to increase the power of their signal.