Probabilistic quantitative microbial risk assessment model of norovirus from wastewater irrigated vegetables in Ghana using genome copies and fecal indicator ratio conversion for estimating exposure dose

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The need to replace the commonly applied fecal indicator conversions ratio (an assumption of $10^{-5}$ virus to fecal indicator organism) in Quantitative Microbial Risk Assessment (QMRA) with models based on quantitative data on the virus of interest has gained prominence due to the different physical and environmental factors that might influence the reliability of using indicator organisms in microbial risk assessment. The challenges facing analytical studies on virus enumeration (genome copies or particles) have contributed to the already existing lack of data in QMRA modelling. This study attempts to fit a QMRA model to genome copies of norovirus data. The model estimates the risk of norovirus infection from the intake of vegetables irrigated with wastewater from different sources. The results were compared to the results of a corresponding model using the fecal indicator conversion ratio to estimate the norovirus count. In all scenarios of using different water sources, the application of the fecal indicator conversion ratio underestimated the norovirus disease burden, measured by the Disability Adjusted Life Years (DALYs), when compared to results using the genome copies norovirus data. In some cases the difference was > 2 orders of magnitude. All scenarios using genome copies met the $10^{-4}$ DALY per person per year for consumption of vegetables irrigated with wastewater, although these results are considered to be highly conservative risk estimates. The fecal indicator conversion ratio model of stream-water and drain-water sources of wastewater achieved the $10^{-6}$ DALY per person per year threshold, which tends to indicate an underestimation of health risk when compared to using genome copies for estimating the dose.

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