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Flow and active mixing have a strong impact on bacterial growth dynamics in the proximal large intestine JONAS CREMER, IGOR SEGOTA, CHIH-YU YANG, MARKUS ARNOLDINI, ALEX GROISMAN, TERENCE HWA, University of California, San Diego — More than half of fecal dry weight is bacterial mass with bacterial densities reaching up to 10^{12} cells per gram. Mostly, these bacteria grow in the proximal large intestine where lateral flow along the intestine is strong: flow can in principal lead to a washout of bacteria from the proximal large intestine. Active mixing by contractions of the intestinal wall together with bacterial growth might counteract such a washout and allow high bacterial densities to occur. As a step towards understanding bacterial growth in the presence of mixing and flow, we constructed an in-vitro setup where controlled wall-deformations of a channel emulate contractions. We investigate growth along the channel under a steady nutrient inflow. Depending on mixing and flow, we observe varying spatial gradients in bacterial density along the channel. Active mixing by deformations of the channel wall is shown to be crucial in maintaining a steady-state bacterial population in the presence of flow. The growth-dynamics is quantitatively captured by a simple mathematical model, with the effect of mixing described by an effective diffusion term. Based on this model, we discuss bacterial growth dynamics in the human large intestine using flow- and mixing-behavior having been observed for humans.

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