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Introduction: Bile acids have emerged as hormone-like regulators of energy metabolism. Consequently, factors that control bile acid concentrations in various pools in the body may play an important role in the control of metabolism and thus metabolic health. The key steps in bile acid transport have been elucidated; however, as a result of the complexity of the enterohepatic circulation, a comprehensive understanding of the relative importance of these steps remains elusive. To better understand how the control of bile acid concentrations is distributed we have developed a mathematical model of bile acid circulation.

Methods: The mathematical model consists of a system of differential equations, which describe the circulation of bile acids as transportation between a series of connected compartments.

Results: The model describes the kinetics of all major bile acids in the enterohepatic circulation and their appearance in systemic circulation. Intestinal compartments are modelled in detail and transit is presumed non-homogeneous; e.g. in the terminal ileum bile acid transit is decelerated before passage into the colon. Additionally, immediately after a meal an implemented gastro-colic reflex affects a short increase of the intestinal transit speed, propelling the intestinal bile acids forward along the digestive tract. The presented model is able to reproduce main characteristics of the human postprandial bile acid response in health and following cholecystectomy.

Discussion/Conclusion: Since only a small fraction of bile acids resides in the systemic circulation while the majority of the pool is found within the enterohepatic cycle, an interesting application of the model is in model-based predictions of the sizes of enterohepatic pools of bile acids from their systemic concentrations. The model may be applicable in any circumstance in which systemic bile acid concentrations change, such as Type II diabetes, dietary intervention, or the increase of bile acid concentrations seen after Roux-and-Y gastric bypass.