Title: NONINVASIVE AVERAGE FLOW ESTIMATION FOR AN IMPLANTABLE ROTARY BLOOD PUMP USING DIMENSIONAL ANALYSIS

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OBJECTIVES
Accurate non–invasive average flow estimation of implantable rotary blood pumps is an important element for their physiological control. While most attempts at developing such a flow estimate model have involved purely empirical techniques, the present study aims to use a systematic nondimensional approach to derive the relationship between pump power, speed, haematocrit level, flow and pressure.

METHODS
Based on data obtained from a steady flow mock loop under a wide range of pump operating points and fluid viscosities, a flow estimate model was obtained using dimensional analysis. The algorithm is then validated using data from two other pumps having similar hydraulic characteristics.

RESULTS
Linear correlations between estimated and measured pump flow over a flow range of 0.5 L/min to 8 L/min resulted in a slope of 0.95 with an R2 value of 0.98. The average value for residuals of flow estimation was 0.21±0.15 L/min (mean±standard deviation) and the average percentage error was 6.14%.

CONCLUSIONS
The study demonstrates that dimensional analysis gives better accuracy than reported empirical approaches. In comparison with empirical model fitting, this approach proves to be more accurate while also providing valuable insights into relationships between various fluid mechanics parameters and estimated pump flow.