	Equation	Notes
Blood flow (F or Q)	$= \dfrac{\Delta \text{Pressure } (\Delta P)}{\text{Resistance } (R)}$ Q → mL/min P → mm Hg R → Hg/mL per min	▪ To increase Q, one could either increase the pressure difference (increased cardiac force) or decrease the systemic vascular resistance (dilate blood vessels). ▪ The direction of blood flow is determined by the direction of the pressure gradient and always is from high to low pressure. ▪ The major mechanism for changing blood flow is by changing the resistance particularly the arterioles.
Velocity of blood flow (v)	$= \dfrac{\text{Blood flow (Q)}}{\text{Cross - sectional area (A)}}$ Q → mL/sec V → cm/sec R → cm^2	▪ Aorta has Low cross sectional area (2.5) so the velocity of blood is high ▪ The capillary has a high cross sectional (2500) area so the velocity is low
Reynolds' number (Re)	$= \dfrac{\text{Density}(\rho) \times \text{Velocity}(V) \times \text{Diameter}(D)}{\text{Viscosity } (\mu)}$	▪ Dimensionless number used to predict if blood flow will be laminar or turbulent. ▪ When Reynolds' number rises above approximately 2000, turbulence will usually occur, even in a straight, smooth vessel. ▪ In the proximal portions of the aorta and pulmonary artery, Reynolds' number can rise to several thousand during the rapid phase of ejection by the ventricles ▪ Increased in anemia ... why? 1. due to decreased blood viscosity 2. high cardiac output, which causes an increase in the velocity of blood flow ▪ Increased in presence of thrombi ... why? Thrombi narrow the diameter of the blood vessel, which causes an increase in blood velocity at the site of the thrombus, thereby increasing Reynolds number
Main arterial pressure (MAP)	= Cardiac output (CO) x TPR TPR → Total peripheral resistance R unit is PRU → peripheral resistance unit	▪ Resistance occurs as a result of friction between the flowing blood and the endothelium all along the inside of the vessel. ▪ Resistance is the impediment to blood flow in a vessel.
Conductance	= 1/ Resistance	▪ Measure of the blood flow through a vessel for a given pressure difference. ▪ The conductance increases in proportion to the fourth power of the diameter. $\text{Conductance} \propto \text{Diameter}^4$

	Equation	Notes
Poiseuille's Law	$F = \frac{\pi \times \Delta Pressure (\Delta P) \times (radius)^4}{8 \times viscosity (\eta) \times length (l)}$ l → length of the vessel	▪ The rate of blood flow is directly proportional to the fourth power of the radius of the vessel ▪ The viscosity of whole blood at a normal hematocrit is about 3 to 4
Resistance	Series Resistance: R total= R1 + R2 + R3 + ... Parallel Resistance: $\frac{1}{R\ total} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + ...$	▪ In parallel circuit, the total resistance is far less than the resistance of any single blood vessel. ▪ The viscosity of whole blood at a normal hematocrit is about 3 to 4
Vascular distensibility	$= \frac{\text{Increase in volume}}{\text{Increase in pressure x original volume}}$	▪ The fractional increase in volume for each mm Hg rise in pressure. ▪ The veins, on average, are about 8 times more distensible than the arteries
Vascular compliance (capacitance)	$= \frac{\text{Increase in volume}}{\text{Increase in pressure}}$ = Distensibility x volume	▪ The total quantity of blood that can be stored in a given portion of the circulation for each mm Hg pressure rise. ▪ The compliance of a systemic vein is about 24 times that of its corresponding artery because it is about 8 times as distensible and has a volume about 3 times as great (8 × 3 =24)
Pulse pressure (pp)	$\approx \frac{\text{Stroke volume}}{\text{Arterial compliance}}$ = Systolic pressure – Diastolic pressure	▪ Two major factors affect the pulse pressure: (1) the stroke volume output of the heart; and (2) the compliance (total distensibility) of the arterial tree. A third less important factor is the character of ejection from the heart during systole.
Mean arterial pressure (MAP)	= 2/3 DBP + 1/3 SBP = DBP + 1/3 PP	▪ Measured at resting heart rate. ▪ At normal heart rates, a greater fraction of the cardiac cycle is spent in diastole than in systole. Thus, the arterial pressure remains closer to diastolic pressure than to systolic pressure
Starling Equation	$J_v = K_f ([P_c - P_i] - [\pi_c - \pi_i])$ Jv → fluid movement (mL/min) Kf → Hydraulic conductance (mL/min per mm Hg) Pc → Capillary hydrostatic pressure (mm Hg) Pi → Interstitial hydrostatic pressure (mm Hg) πc → Capillary oncotic pressure (mm Hg) πi → Interstitial oncotic pressure (mm Hg)	▪ The Starling equation states that fluid movement across a capillary wall is determined by the net P across the wall, which is the sum of hydrostatic P and oncotic P. ▪ Pc &πi are a forces favoring filtration ▪ Pi & πc are a forces opposing filtration ▪ πc & πi are determined by the protein conc. ▪ kf: water permeability of the capillary wall The magnitude of fluid movement is largest in capillaries with the highest Kf. ▪ Kf is increased in capillary injury

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