KQuIP Hub: Pro forma for measurements and tools, relevant for use in the renal setting

Name of measurement / tool	Relative blood volume (RBV) monitoring
Variable to be measured	The blood volume is measured as a percentage of the blood volume at measurement initiation, giving the relative blood volume (RBV). Blood volume monitoring is often used in haemodialysis treatments, to monitor changes in blood volume throughout the treatment as fluid is removed. This can give an indication of how well patients are tolerating fluid removal and fluid status, in real-time during the treatment.
Brief description of the measure / tool	RBV devices measure changes in fluid status of the blood passing through the dialysis lines. This is done by monitoring the concentration of one or some of the constituents of whole-blood, such as haemoglobin or haematocrit. There are several approaches to measurement, including optical absorbance or transmission, the speed of ultrasound or conductivity, but all effectively monitor relative changes in plasma water concentration in the blood.
Relevance to the renal community	Fluid removal during haemodialysis is fundamentally limited by the ability for fluid to pass from the tissues into the blood, known as refilling. For excess fluid to be removed safely during haemodialysis, refilling needs to occur at same the rate or quicker than the fluid removal by the haemodialysis machine. There are significant differences between patients in how quickly fluid refills into the blood. RBV devices can detect reductions in blood volume in real time, offering the potential for prevention of low blood pressure and improved fluid assessment.
Relevance for a renal related QI project Describe how the measure / tool could be used in a renal QI project. This may not be exhaustive but may inspire others.	RBV devices can provide a measure of the degree to which blood volume has been reduced during haemodialysis. This could be useful for QI projects that include efforts at improving safety, patient tolerance or symptoms during haemodialysis.

Accreditation (e.g. endorsed by a recognised organisation)	None	
Validation (e.g. scientific and/or clinical validation)	There is a lack of validation for use of RBV. The test relies on an assumption that the amount of red blood cells and the distribution of red blood cells do not vary during a treatment session, something which has been debated (1-2). Clinical validity is also lacking; there is no standard approach to interpretation of RBV tests and the single randomised controlled trial testing RBV as a guide to fluid management showed better outcomes for the control group (3).	
Impact upon the patient pathway Is this part of patient's normal care or in addition to this? How much will it alter the patient's care?	RBV devices monitor blood in the dialysis lines, so the test has no impact upon the patient and is often incorporated into current haemodialysis machines.	
Expertise / Skill / Professional Registration required to use the measurement / tool	Obtaining RBV measurement requires little training. However interpreting the results requires training to ensure they interpreted accurately.	
Resources needed E.g. Medicines, devices, healthcare professionals	Equipment and Consumables	Many modern haemodialysis machines have a device for monitoring blood volume inbuilt, although some need special blood lines to be used for sessions where RBV is employed. These can be slightly more expensive than standard blood lines. If it is not available within the haemodialysis machine, then standalone monitors can be purchased.
	Time	The monitor is either: • Initiated by a simple push-button and automatically monitors the RBV for as long as the treatment lasts or • Can be set to automatically initiate. This is dictated by the haemodialysis machine.
	Training	No training is needed for measurement although some experience/understanding of the technique is advisable before using the results for patient management.

	Licenses	None extra required – included in the haemodialysis machine purchase.
How to access the measurement / tool	Check whether local haemodialysis machines offer measurement of relative blood volume or contact renal suppliers to for a stand alone module.	
Main strengths of the measurement / tool	The measurement is relatively cheap, simple to perform, well tolerated and has good clinical validity.	
Main limitations of the measurement / tool	Measurement artefacts are not uncommon and can lead to results with significant errors. Some degree of training and technical support to be able to identify measurement artefacts is recommended.	
References	1) Mitra, S., Chamney, P., Greenwood, R. & Farrington, K. 2004. The relationship between systemic and whole-body hematocrit is not constant during ultrafiltration on hemodialysis. *Journal of the American Society of Nephrology: JASN,* 15**,** 463-469. 2) Schneditz, D., Ribitsch, W., Schilcher, G., Uhlmann, M., Chait, Y. & Stadlbauer, B. 2016. Concordance of absolute and relative plasma volume changes and stability of Fcells in routine hemodialysis. *Hemodialysis international. International Symposium on Home Hemodialysis,* 20**,** 120-128. 3) Reddan, D., Szczech, L. A., Hasselblad, B., et al. 2005. Intradialytic blood volume monitoring in ambulatory hemodialysis patients: a randomized trial. *Journal of the American Society of Nephrology : JASN,* 16**,** 2162-2169.	