**Investigation of potential quality improvements using BD Vacutainer® Barricor™ tubes for Primary Care glucose samples.**

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**Background**

Fluoride as a preservative of blood glucose has been widely used for decades (1). The rapid separation of plasma from cells is also an acceptable stratagem to maintain glucose concentration for analysis (2), this is usually impractical in primary care:

- The requirement to leave serum samples for a minimum of 30 minutes prior to centrifugation to allow for complete clot formation (3)
- re-suspension of cells and platelets in plasma samples (post-centrifugation but prior to testing) due to sample perturbation (4)
- sourcing a centrifuge fit for purpose and all within the confines of the blood collection and administration processes within General Practice.

However, if these problems can be overcome, not only are there improvements to be made in the quality of glucose results generated by laboratories for primary care patients, but also the ability to use the same samples for testing of other analytes offered by Biochemistry laboratories. This in turn will generate efficiencies by reducing sample numbers, as well as improving the quality of results for analytes other than glucose.

**Materials & Methods**

Patients attending a local GP surgery were consented to provide an additional (Barricor™) blood sample to the glucose request. These Barricor™ samples were separated immediately (within 10mins) on-site at 4000g for 3 minutes only. Both Barricor™ and F/EDTA samples were transported to the laboratory and processed under the same conditions.

**Results**

Matched F/EDTA and Barricor™ tests results (n = 44) were analysed for statistical and clinical significance. Results showed that Barricor™ tube glucose results were significantly higher than F/EDTA tubes (p<0.0001). Mean average for the Barricor™ tubes was 6.19 mmol/L, for the F/EDTA tubes 5.88 mmol/L.

The mean percentage difference for Barricor™ tubes over F/EDTA tubes was 5.0% higher (Table 1)

**Discussion**

It had been collected to collect more data points than the 44 presented, however the practicalities of matching the Barricor™ sample and request form with often both a serum and a F/EDTA sample/request form in a Department receiving 5000 samples per day, meant that many Barricor™ glucose requests were missed.

Fluoride acts on the enzyme enolase in the glycolytic pathway, but enzymes upstream of enolase in the glycolytic pathway continue to metabolise glucose before feedback inhibition greatly decreases their activity (6). Though stabilising glucose levels, Fluoride does not prevent the inhibition of glycolysis during the first 30-90 minutes after collection (1), and perhaps up to 4 hours (7). The addition of citrate to Fluoride/EDTA tubes, to acidify the blood, has been proposed as a method to increase the recovery of glucose levels. Fi/Citrate tubes show only a 0.3% drop in glucose at 2 hours and 1.2% at 24 hours, compared with a 4.5% drop at 2 hours and 7.0% at 24 hours for Fluoride inhibited samples only (7). The latter compares well with the data presented here.

However, commercially available Fi/Citrate tubes require conformance of sampling to the fill-line on the tube, and the use of multiplication factor to reflect the dilutional ratio between the sample and anticoagulant volume and final fill volume (8). This may necessitate the inclusion of pre-analytical checks of sample volume similar to those in place for coagulation studies.

Given Recommendation 5 of the 2006 WHO guidelines (5):

“Glucose should be measured immediately after near-patient testing, or if a blood sample is collected, plasma should be immediately separated, or the sample should be collected into a container with glycolytic inhibitors and placed in ice-water until separated prior to analysis.”

The use of glycolytic inhibitor tubes in Primary Care is impractical for the purpose of glucose estimation, and Near-Patient Testing has greater capital, running and quality administration costs compared to a Laboratory provided service. Furthermore, the continued use of F/EDTA tubes outside of the guidelines leads to an under-recovery of glucose levels which can skew epidemiological data, and mis-identify patients at risk (9) (10) Table 1 highlights 3 patients whose Barricor™ glucose levels were at or above the 6.1mmol/L WHO threshold for IFG (assuming the samples were fasting) compared with the paired F/EDTA samples, where the levels were below the threshold (approximately 7% of the sample group). Rapid blood separation has also been found to be superior by others (11)

Clearly, the separation of plasma from blood cells in a lithium/heparin tube facilitates the measurement of other analytes also. During the 12 month period February 2016 to January 2017, the Belfast Trust laboratories processed 4268399 samples from Primary Care, of which 60462 were plasma glucose samples in F/EDTA tubes (13.85% of the total). Whilst not all glucose requests would be associated with a separate serum sample for other Biochemistry analytes, a significant number are. Use of the Barricor™ tube with rapid separation therefore allows consolidation of samples that are currently being processed separately, and with increased confidence in sample quality (including diminishing the likelihood of cross-contamination from different blood tube types). Furthermore, the overall reduction in sample numbers helps to offset the costs of introducing the Barricor™ tube, and introduces efficiencies throughout the patient testing pathway, particularly in sample processing at the Laboratory.

**Conclusions**

Use of Barricor™ tubes with immediate separation appears to be superior in maintaining plasma glucose levels than F/EDTA tubes with later separation in the laboratory. As Barricor™ tube plasma can also be used for many other analytes, there are economic advantages to be obtained from:

- No requirement or cost of taking an extra Fluoride plasma tube
- Processing efficiencies due to reduced laboratory workflow

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**References**