Potential use of the 25µl Capillisafe Pastette (Alpha Labs) as a blood collection device for the measurement of heavy metals.

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Introduction:

Heavy metals found in the food chain/environment can be detrimental to human health, even at low concentrations. Children, are more at risk because of increased hand-to-mouth behaviour, increased gastro-intestinal absorption and due to the metals crossing the developing blood-brain barrier. Exposure to heavy metals is usually ascertained by measuring concentration(s) in a venous blood sample. This however, requires a visit to the nurse/phlebotomist at a GP surgery, community centre or hospital. Venous sampling also enhances the risk of vein damage and creates stress for parents and child, especially if needle-phobic. Capillary sampling is now growing in popularity and used in paediatric patients within clinical/non-clinical settings[1], for tests requiring small blood volumes.

Aim:

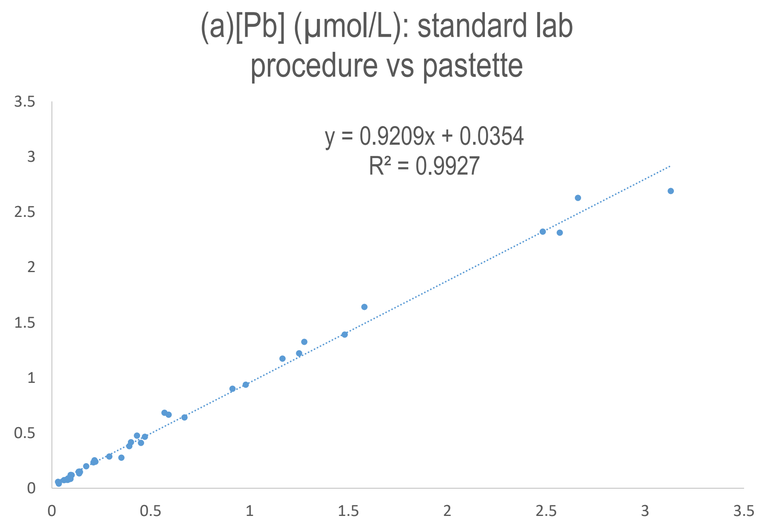
To investigate the potential use of the 25µl pastette as a capillary blood sampling device for measurement of some heavy metals.

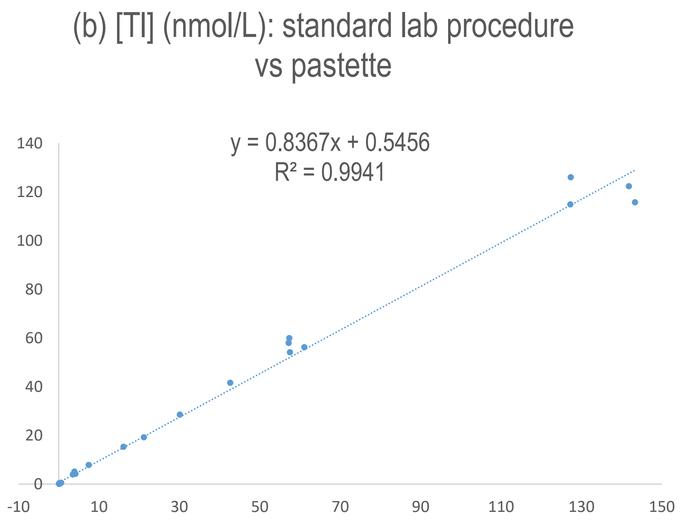
Materials and Methods:

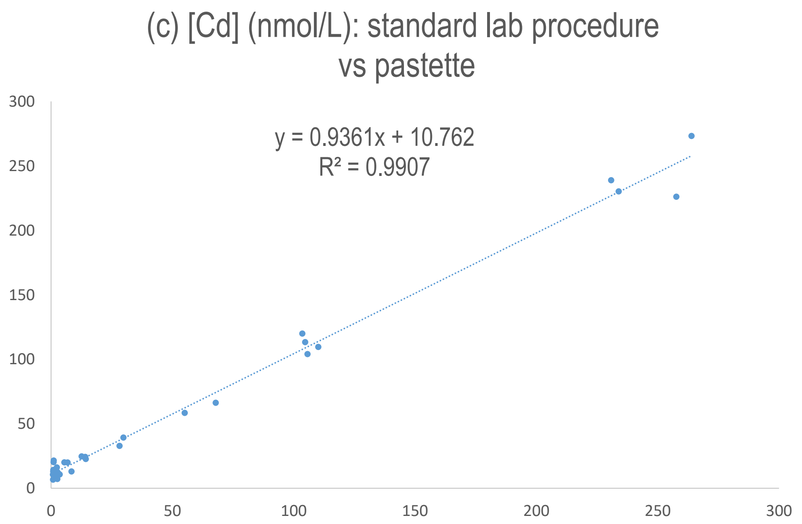
- The 25µl pastette (catalogue no LW 4425) was obtained from Alpha Labs. A drop from a well-mixed, surplus venous blood sample that had trace elemental concentration(s) previously determined, was transferred to a clean flat surface.
- The pastette was directed horizontally to the spot: blood was automatically drawn to a fixed line/volume.
- The blood was immediately transferred to a polypropylene tube containing 1% nitric acid (HNO_3) containing Gallium, Rhodium and Rhenium as internal standards.
- Post-capping, the tube was mixed and centrifuged. For sample blanks, water was used instead of whole blood.
- The heavy metals Lead (Pb), Cadmium (Cd) and Thallium (Tl) were simultaneously measured in the samples using Inductively-Coupled Plasma Mass Spectrometry (ThermoFisher Scientific ICAP-Q/RQ).
- Concentrations were compared against those obtained using our standard laboratory procedure for sample preparation and analysis.

Results:

The pastettes did not contribute any significant contamination for either Pb or Tl, as reflected by mean blank values (n=4) of 0.008 µmol/L and 0.07 nmol/L, respectively. Concentrations for blanks for Cd were however, significant (>10nmol/L) and highly variable.
Intra-assay variability for pastette drawn commercial Quality Controls (n=5), at three different levels, for Pb and Tl ranged 3.9-6.8%, whilst the inter-assay variability (n=4-6) ranged from 4.5-7.3%. Cd showed marked variability.
Spiked blood samples, drawn up using the pastettes, depicted recovery values for Pb of 88.4-106.7% (compared to 99.3-117.6% via standard lab process). Tl similarly demonstrated recovery values of 88.5-127% (vs 96.6-117.4%, via standard lab process).
A very good correlation (for samples at various concentrations) was evident between the pastette and the standard lab procedure for blood Pb (Fig a) and Tl (Fig b). Cd also showed a fairly good correlation (Fig c); the higher concentrations however, masked the variability seen at the lower concentrations. The R^2, when only Cd concentrations up to 50nM were included, was 0.74.







Conclusion:

This study indicates that the pastette could potentially be a useful remote collection device for a finger prick blood sample, provided bleeding/collection information and a lancet plus diluent-containing tube is provided. The sample/tube could then be posted to the laboratory for Pb and Tl measurements. The sample collection device could be applied to other heavy metals.
A study utilising actual finger-prick vs venous samples is however, necessary to further validate the use of this collection device.

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References:

1) AJ Chetwynd *et al* (2022) Perceptions and acceptability of microsampling in children and young people: a single-centre survey. BMJ Paediatr Open. 30, 6(1), e001716. doi:10.1136/bmjpo-2022-001716