Zealand

Replication of ”Comparison of Spectrophotometric Methods for the Determination of Carboxyhemoglobin in Postmortem Blood” by J. M. Samuel, J. H. Kahl, M. E. Zaney, G. W. Hime, D. M. Boland. A declaration of intent

Lars Kjær, Associate Professor, Zealand Academy of Technologies and Business, lakj@zealand.dk

In recognition of the recently uncovered problem of replication seen in the natural sciences (Devito & Goldacre, 2021) Zealand Academy of Technologies and Business are building a system for the consistent and methodical replication of key parts of the literature. Part of this problem is bad statistics, cherry picking or outright fraud, but a significant portion is survivorship bias, where only the interesting (and thus odd) findings get published (Devito & Goldacre, 2021). While some of these problems are only really solvable by remedying the incentives of those who do science, survivorship bias is a problem which would be remedied simply by replication of the paper as it is. In general, there is in the industry an appetite for more rigorous replication of studies, accompanied by a feeling that doing so yourself would be counterproductive to one´s career (Baker, 2016).

Thus, there is a niche available for the lab technician educations to help out the field in general, as we are under less pressure to publish high impact, while having the skills to carry out good replicates. We intend to achieve this by hiring lab technician trainees to replicate articles as the final part of their educations. To correctly estimate the resources required for this we must first have a realistic expectation of how much supervision and support this would require. Thus, we are hiring a student over the summer to carry out a single replication.

As an initial test of our ability to carry out this task, and to have a more accurate estimate of the resources required we are carrying out a replicate of the paper:” Comparison of Spectrophotometric Methods for the Determination of Carboxyhemoglobin in Postmortem Blood” (Samuel, Kahl, Zaney, Hime, & Boland, 2021).

The article has been chosen for its relevance and simplicity. As an evaluation of the measurement of carbon monoxide in post-mortem blood it is directly relevant to the forensic chemical community, where secondary confirmation of the methodology has great value vis-à-vis lifting the burden of proof that the profession requires. Thus, a replicate would be of real value to a well-defined community.

Secondly as our replicate must take place over a summer vacation (for student availability), in our existing facilities, we required a fairly simple paper. Subsequent studies would by default be scaled up as a lab technician student is employed for a whole year, and further funds for equipment could perhaps be acquired for a larger project.

It is our intention to replicate the following experiments:

Two wavelength measurements according to (Katsumata, Aoki, M, Suzuki, & Yada, 1980)

Derived spectroscopy according to (Parks & Worth, 1985)

Multicomponent spectroscopy according to (Attia, et al., 2015)

Two component plus multicomponent according to (Rodkey, Hill, Pitts, & Robertson, 1979)

All the methods will be optimized until the standard has R^2 of 0.99 or better.

In accordance with the original paper, we intend to test both variance between and within sets.

For this purpose, Forensic Chemistry at SDU has kindly agreed to provide us with both good, fire damaged and degraded samples for measurement. In accordance with the original experiments it is our intention to use 6 original samples of each type for the comparison.

It may not be possible to find a version of the original CO-oximeter used by Miami-Dade County Medical Examiners Department (as this study was carried out specifically because the oximeter was out of production), if so we will try to acquire blood samples already measured in such a manner, for comparison.

The resultant measurement will be communicated via EAviden.dk, and we will offer the original publication either to link or publish the findings in their own right. Measurements will be carried out summer 2022.

References

Attia, A. M., Ibrahim, F. A., Abd El-Latif, N. A., Aziz, S. W., Abdelmottaleb Moussa, S. A., & Elalfy, M. S. (2015). Determination of human hemoglobin derivatives. *Hemoglobin*, s. 371–374.

Baker, M. (2016). 1500 scientist lift the lid on reproducibility. *Nature*, 452-454.

Devito, N., & Goldacre, B. (25. 06 2021). *Catalog of Bias*. Hentet fra Catakig of Bias: https://catalogofbias.org/biases/publication-bias/

Katsumata, Y., Aoki, M., M, O., Suzuki, O., & Yada, S. (1980). Simultaneous determination of carboxyhemoglobin and methemoglobin in. *Journal of Forensic Sciences*, s. 546-549.

Parks, J., & Worth, H. G. (1985). Carboxyhemoglobin determination by second-derivative spectroscopy. *Clinical Chemistry*, s. 279–281.

Rodkey, F. L., Hill, T. A., Pitts, L. L., & Robertson, R. F. (1979). Spectrophotometric measurement of carboxyhemoglobin and methemoglobin in blood. *Clinical Chemistry*, s. 1388–1393.

Samuel, J. M., Kahl, J. H., Zaney, M. E., Hime, G. W., & Boland, D. M. (2021). Comparison of Spectrophotometric Methods for the Determination of Carboxyhemoglobin in Postmortem Blood. *Journal of Analytical Toxicology*, s. 885–891.