Editorial

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Drone transport of biological samples: an open issue

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Laboratory and clinical scientific communities have long neglected the issue of secure sample transportation and biological sample integrity. However, in the last few decades, the accumulated body of evidence demonstrating vulnerability in the pre-analytical phase has led to a better understanding that the secure transportation of biological samples is a fundamental step in the pre-analytical pathway itself, and is of crucial importance in assuring the reliability of further analytical procedures [1, 2].

Concerning sample transportation, attention has been focused on the following main sectors: a) internal (in-house) sample transportation, and b) external sample transportation. A related issue that cannot be considered in the specific context of sample transportation, the so-called “prehospital preanalytical phase”, concerns laboratory tests and interventions undertaken during the emergency transport of patients by ambulance, helicopter, and aeroplane [3].

Internal transportation should be manual or automated. The former is very reliable but costly, and often incurs delay in results reporting, particularly in urgent and life-threatening medical conditions. Consequently, an increasing number of hospitals use the latter form of transportation with, for example, pneumatic tube transportation systems (PTS), and electric track vehicles [4]. Recently published papers and systematic reviews in the literature have provided important findings on sample transportation by PTS, highlighting the need to evaluate some specific variables (i.e. acceleration forces), and improve on quality and patient safety [5]. These studies also point to the need to establish quality target thresholds and, whenever necessary, use innovative PTS systems that minimize the risk of physical stress in transported samples, thus reducing the risk of pre-analytical errors [6, 7]. External sample

transportation is much more complex, since it is undertaken using numerous different means, such as car, plane, train and, more recently, drones.

In this issue of the *Journal*, Perlee and Colleagues report interesting data on the effect of drone transportation on the stability of several biochemical, hematological and coagulation parameters, in particular, on the stability of 39 commonly requested measurands in samples collected from 20 healthy individuals. In total, four drone flights were undertaken over a two-day time period, a distance of 30 km being covered at approximately 70 km/h, at an altitude of 100 m [8]. The study design allowed a comparison to be made between laboratory results following immediate measurement (control), late measurement and measurement after transportation by car and by drone, respectively. On checking samples for hemolysis, icterus and lipemia using serum indices (HIL), no significant change in HIL indices was found, and no significant differences were found between groups for the majority of measured parameters other than eight measurands (glucose, phosphate, potassium, chloride, hemoglobin, platelet count, activated partial thromboplastin time [APTT], and lactate dehydrogenase [LD]). Furthermore, by adopting the minimum and desirable performance specifications of total allowable error obtained from the EFLM database [9], the authors investigated whether the differences observed were clinically significant. After transportation, a clinically significant increase was found in lactate dehydrogenase and potassium levels.

The paper by Perlee and Colleagues is welcome, as it provides further evidence of the need to carefully consider the possible effects of sample transportation, including that in drones. In fact, few data are available on the stability of biological samples and related laboratory parameters. However, as highlighted by the authors, the study has some major limitations, particularly in relation to the unexplained cause of the increase found in levels of LD and potassium, both markers of hemolysis, whereas no significant change was found in HIL indices. The authors also point out that their study lacked pathological samples with laboratory results outside the reference intervals. In a

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recent study, Johannessen and Coll. investigated the effect of drone transport on pathological samples and reported significant increases in AST, LD and the lipid index, which might have been obviated by performing sample centrifugation before the flight [10]. Therefore, sample transportation requires further investigation in order to gain effective evidence of possible effects not only in samples from healthy individuals (reference subjects), but also in samples from patients with pathological conditions and values outside the reference intervals, thus improving our understanding of the clinical significance of possible differences before and after transportation.

However, an additional, intriguing aspect is to improve our understanding as to why, when and how there is the effective need to adopt drones or other tools for external transportation and, in particular, to support consolidation projects of laboratory services, with the consequent need for long-distance sample transportation. Certainly, the attempt to reduce costs cannot be the exclusive rationale for this strategy, as other important variables to take into consideration include an accurate analysis of economic and clinical outcomes, and safety and quality in all steps of the testing process, including appropriate advice in results interpretation/utilization in the post-analytical phase. Moreover, developments in point-of-care testing (POCT) should offer a valuable alternative to sample transportation in many settings, and this opportunity, as well as the so-called “Zero Kilometer” concept, is gaining increasing interest and consensus [4, 11].

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