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Analysis of the Use of Dried Blood Spot Measurements in Disease Screening

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Abstract

The collection of dried blood spots on filter paper offers a powerful tool in screening programs and in large population-based surveys. The method has the advantage of being less invasive and relatively painless and is particularly suitable for collection in neonates and the elderly. Blood can be collected and transported economically without requiring a cold chain. The use of blood spots for the measurement of insulin, high sensitivity C-reactive protein, and triglycerides is reported. A good correlation between measurement of these analytes in dried blood and sera suggests that the method is valid and has the potential to be used for the screening of cardiometabolic risk factors. This method of blood collection is particularly suited for developing countries where cost cutting is important.

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The collection of dried blood spots on filter paper blotters for the measurement of analytes has opened up a relatively noninvasive option for the collection of samples for neonatal screening and large-scale epidemiological studies. The concept of obtaining blood on filter paper was introduced in 1963 by Guthrie and Susi[1] for the screening of metabolic diseases and since then the measurement of numerous analytes using the blood spot method has been published. This approach for collecting blood has facilitated population screening of newborns for the detection of treatable, inherited metabolic diseases. In principle, any analyte that can be measured from whole blood, serum, or plasma can also be measured from blood dried on filter paper. The only caveats are that the analytes to be measured from dried blood must be stable to drying and must be selectively released from the paper upon elution. Also, stability studies of analytes on storage are a prerequisite for large-scale epidemiological use of the dried blood as this is likely to vary from analyte to analyte. The dried blood matrix stabilizes many analytes, including DNA, thereby allowing measurement of both phenotype (biochemical marker) and genotype (mutation or polymorphism) from a small volume of blood. The Centers for Disease Control and Prevention (CDC) maintain an independent quality control program for blood spots, and as per CDC reports, the filter paper blood collection device has achieved the same level of precision and reproducibility as that of standard methods for collecting blood, such as vacuum tubes and capillary pipettes.[2]

Procedures for blood sample collection on filter paper, processing, and storage have been fairly standardized and are easily adaptable. Analysis of blood spots, however, poses few challenges, mainly that of elution of red blood cells along with the analyte of interest.

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Cellular components rupture when whole blood samples are dried on filter, which subsequently get released into solutions when blood spots are reconstituted. Additional extraction procedures may be required for certain analytes to overcome this problem. Efficiency of elution of the analyte of interest and relative sample volume of sample collected are two other issues of concern in analysis with dried blood. Despite these limitations, dried blood spots have several advantages. The collection of capillary blood through heel or finger prick is relatively painless and noninvasive, unlike venipuncture, which may be difficult in infants and the elderly. There is no need for centrifugation and separation of samples, making dried blood suitable for field applications with minimum involvement of laboratory-trained personnel. Most analytes are stable at room temperature on drying for at least a week, thereby bypassing the need for maintaining a cold chain for transportation of the sample. Blood spots further represent a low infectious hazard, as many viruses known to be present in serum or plasma lose infectivity as a consequence of disruption of their envelope on drying.

The article by Sanjay Kapur *et al.*[3] reports blood spot testing of cardiometabolic risk factors. Hypertriglyceridemia, elevated C-reactive protein, and insulin resistance are risk factors for cardiometabolic disease, and identifying subjects at high risk in a population would greatly benefit in formulating strategies. For large population-based surveys, ease of biological sample collection, storage, and transportation are desired, and to this effect the blood spot provides a friendly and painless option. The blood spot method described by the authors[3] is an effort in this direction. For validation of blood spot assays, levels of analytes in dried blood were compared with those in serum. A good correlation is reported between dried capillary blood and serum obtained through venipuncture. The analytical performance in terms of precision and reliability has been improved upon in the present study as compared to previously reported studies. Using a microtiter plate, the authors[3] were able to reduce the requirement of the sample. A clear description of the methodology for the elution of analytes has been provided,[3] and because commercially available reagent kits were used for estimations, the assays can be adapted easily by laboratories.

Dried blood spots are particularly suited for population-based surveys in developing countries where cost cutting is important in view of limited health budgets. A less expensive option for collection and transportation, such as blood spots, has tremendous application in such surveys. However, in view of varied climatic conditions in different parts of the world, dried blood spot collection in field conditions, as well as their transportation, needs to be addressed prior to widespread usage of this method in different countries.

References:

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