Journal of Diabetes Science and Technology
Volume 4, Issue 2, March 2010
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SYMPOSIUM

Use of Dried Blood Spots: An Ideal Tool for Medical Anthropology "in the Field"

Daniel C. Benyshek, Ph.D.

Abstract

The use of dried whole blood spot samples provides medical anthropological researchers—especially those working in remote, isolated communities—with several advantages over traditional methods. Anthropological research utilizing venous-drawn blood samples can create challenges in terms of phlebotomy training, personnel needs, storage and transportation requirements, and participant discomfort. Alternatively, research utilizing dried blood spot samples, via finger stick collection techniques, eliminates or reduces these problems greatly. While the use of dried blood spots is often the best sampling option for anthropologists or other population-level researchers, the method does have some limitations. Nevertheless, as the number of dried blood spot analyte protocols continues to increase, the logistical and participant advantages of dried blood spot methods assure their increased utility in biomedical anthropological research in the future.

J Diabetes Sci Technol 2010;4(2):255-257

Biological and medical anthropologists have been doing research with indigenous peoples living in small, isolated settlements and in rural communities in the developing world for decades.[1,2] Broadly speaking, biological anthropologists are interested in human origins, evolutionary processes, and modern human variation. Biological anthropologists working with living human populations want to understand how humans adapt to diverse environments and how biological and cultural processes work together to shape growth and development, health and disease, and patterns of social behavior. In many of these studies, biomedical anthropologists collect biological samples—often of blood, saliva, or urine—that can be transported to and analyzed in the laboratory at a later date.[3–5] Because of the remoteness of many of the communities in which anthropologists work and the frequent lack of modern infrastructure, sampling methods that employ dried blood spot collection may provide an invaluable means of helping researchers cope with these logistical challenges.

As a medical anthropologist interested in diabetes and other obesity-related health disorders, especially among the world's highest prevalence populations, I can personally attest to the advantages dried blood spot technology can have over traditional methods "in the field." Some of my early diabetes research fieldwork was conducted on the Havasupai Indian reservation in northern Arizona in the early 1990s.[6,7] The main residential enclave of the reservation is the village of Supai, a small, isolated community located in a tributary canyon of the Grand Canyon that is home to about 450 full-time residents. Supai is quite remote, as access to the stunning beauty of its tourist-friendly canyon environs can only be gained on foot, horseback, or regular helicopter charter. The tribal community also suffers from among the

Author Affiliation: Department of Anthropology, University of Nevada, Las Vegas, Las Vegas, Nevada

Keywords: anthropology, dried blood spots, fieldwork, minimally invasive

Corresponding Author: Daniel C. Benyshek, Ph.D., Department of Anthropology, University of Nevada, Las Vegas, 4505 Maryland Parkway, Las Vegas, NV 89154-5003; email address daniel.benyshek@unlv.edu

highest adult prevalence of type 2 diabetes in the world—at nearly 50%.[8] In the early 1990s, I was a member of a collaborative team of tribal leaders, reservation community members, and Arizona State University senior researchers engaged in a community-based type 2 diabetes project. The project, initiated and approved by the tribe, had three primary components: (i) basic research in population-based diabetes etiology; (ii) community screening and monitoring for diabetes; and (iii) training and education for local health representatives and concerned community members on issues revolving around diabetes nutrition, prevention, and management.[8] My role in the project included teaching community diabetes education courses, coordinating over 200 blood draws for the basic diabetes research and screening components, and disseminating and discussing screening test results with the project participants.

The diabetes screening and monitoring portion of the community-based project required a venous blood draw from volunteer–participants for a hemoglobin A1c test performed by a paid, clinic-based certified phlebotomist. The expertise and experience of this Havasupai research assistant were essential in this instance, as many of the participants were severely obese and others quite elderly, making venous blood draws extremely challenging in some cases. Despite the skill of this phlebotomist, multiple venipunctures were sometimes required, increasing participant discomfort further, and even preventing participation in the screening program in some cases.

Once the venous blood draws were complete, the blood samples were refrigerated until they were transported out of the canyon later that day. Blood samples were then placed in an ice cooler for helicopter transport to a waiting vehicle at the canyon rim. At this time, the blood samples were transported over 200 miles by car to a commercial laboratory in Phoenix, Arizona where the hemoglobin A1c tests were performed.

The use of dried blood spot sampling for the hemoglobin A1c screening portion of the Havasupai diabetes project would have greatly reduced or eliminated some of the expense, logistical difficulties, and participant complaints associated with venous blood draws outlined earlier. Indeed, dried blood spot methods for hemoglobin A1c were just beginning to be developed when the Havasupai diabetes project was underway.[9] Today, new spring-loaded finger stick lancets make collection of whole blood quick and nearly painless and require only minimal training. Blood spots, when collected on filter paper and dried, do not require immediate centrifugation, can often be stored for weeks at normal room temperatures, and can be transported easily.[10] In most cases, dried blood spot samples can also be shipped domestically and internationally through commercial parcel delivery services with only minimal labeling and/or importation requirements. Also, because of their prolonged sample stability, small size, and stackability, a standard, laboratory-grade freezer can archive between 8000 and 10,000 dried blood spot samples.[10] This increased storage and preservation capacity also allows greater opportunities for future testing as additional analytes are discovered and methods are developed.[10,11]

While the venous blood samples were, with considerable expense and logistical challenge, able to be used for the Havasupai diabetes project, other anthropological field sites can pose even greater logistical challenges. For some anthropologists working in small-scale, technologically simple communities in the Amazon, Africa, Asia, and elsewhere, the use of finger stick dried blood spot samples is simply the most participant-friendly and efficient way in which blood samples can be collected, stored, and transported.

As McDade and colleagues[10] noted, the use of dried blood spot samples in population-level research is subject to some limitations, however. The majority of standard laboratory protocols require the use of serum or plasma, meaning that protocols using dried blood spot samples have to be developed and verified independently. In addition, clinical, diagnostic analyte values are nearly always based on protocols using serum or plasma, and because of differences in sample composition, these may not be directly comparable to analyte values derived from dried whole blood spot samples. In cases where such comparison with serum or plasma values is desired, correction factors can be applied to dried blood spot analyte values, but these correction factors are method specific, and the relationship between serum/plasma values and dried blood spot values can be population specific as well.[12] Preanalytical variability associated with dried blood spot collection (i.e., blood spot serum volume)[13] and transport (sample degradation)[10] has also been identified as a problem associated with the method in some cases.

Beyond these important caveats, however, the future use and development of dried blood spot methods look secure. Today, the number of assays that can be performed using dried blood spot samples is large (over 100) and growing, at the same time that the

sensitivity, reliability, and precision of the method are also advancing.[10,11] Commercial and noncommercial laboratory assays using dried blood spots have now been developed and verified for biomarkers associated with metabolism, inflammation, blood lipids, immune response, and sex steroids, among others. In addition, solutions for many of the problems associated with preanalytic variability identified previously have already been developed. Variation in serum content due to a lack of uniformity in the size of collected whole blood spots, for example, can be minimized by using filter paper with preprinted circles as blood spot size guides,[10] and dried blood spot sample degradation can be reduced by placing desiccants in vapor barrier plastic bags along with the blood spot samples and then placing the bags in waterproof pouches for shipping or storage.[11] As a result of these refinements and advancements in dried blood spot methods, biological and medical anthropologists have an expanding tool kit at their disposal, which, in some cases, makes biomedical research among some of the more remote and isolated communities more comfortable for participants and less logistically challenging for researchers. Through the use of dried blood spot methods and other portable, point-of-care technologies, a new era of biomedical anthropological research has begun.

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