Factors associated with HIV infection among blood donors

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In the current issue of the *Revista Brasileira de Hematologia e Hemoterapia*, Maristone et al.[1] present a field study aimed at the identification of blood donor groups that display an increased risk of HIV infection. The study is performed using data on a sizeable sample - over a hundred thousand first-time blood donor candidates that have passed the initial routine clinical screening process (as stipulated by the current Brazilian legislation)[2-4] at the Hemope Foundation in Recife (northeast of Brazil) between 1998 and 2003, where ~0.2% of blood donors were diagnosed as HIV-positive through posterior blood testing. While this percentage may be considered rather low in general terms, it is comparable to the results of similar studies in Brazil[5], still rather high in comparison with the results of ~0.02% from developed countries[5], and quite reasonable when compared to ~10% observed in sub-Saharan Africa[6]. In any case, the sheer volume of the blood donation process and the grave consequences of HIV blood infection make it imperative to focus further research on local population peculiarities, with the objective of pinpointing the sources of enhanced risk.

The current contribution of Maristone et al.[1] is based on questionnaires comprising the clinical screening, and the posterior serological testing results, both routinely used in selecting blood donors in accordance with the current Brazilian legislation[2-4]. The variables extracted from the questionnaires and then used in the study are schooling, marital status, place of residence, and donation type. Additional variables used in the study stem from the accompanying serological procedure, testing for the presence of core hepatitis B antigen virus (anti-HBc), the hepatitis C antivirus (anti-HCV), human T-type antivirus lymph cells (anti-HTLV 1 and 2), syphilis and the hepatitis B virus surface antigen (HBsAg).

The authors[1] use a multiple logistic model where they first perform stepwise backward elimination to extract the most relevant subset of variables associated with HIV infection: they eliminate sex and marital status, as well as anti-HCV, anti-HTLV and HBsAg test results as irrelevant. Next, for each of the remaining variables (potential risk factors) they define a reference group, and fixing all the other independent variables they use the Odds Ratio (OR) to quantify the (relative) degree of association with HIV infection.

The results of the analysis are in line with what is found in other similar works: increased risk is found to be associated with lower donor age, lower education level and presence of other sexually transmitted diseases. In particular, OR = 11.8 for spontaneous donation and OR = 4.3 for replacement donation, taking autologous/specific donation as reference, may come as somewhat of a surprise (spontaneous blood donation is commonly perceived as an altruistic act, and the observed high value of the OR implies a pronounced inconsistency with this view), but has also been observed in other studies on Brazilian blood donation practice[7,8]. This finding is attributed[1,7,8] to a common misconception among high risk individuals that blood test results obtained at donation centers are more reliable than those from the specialized laboratories, which leads them to pretend to be donors, while in fact looking for reliable diagnosis - therefore jeopardizing the overall blood collection practice.

Besides having merit in their own right by shedding light on the local population peculiarities that may have impact on the HIV infection risk, the quantitative results obtained by Maristone et al.[1] open up the possibility of a new venue of research that may help diminish the infection risk in practice. More precisely, the question may now be raised as to how precisely these findings may be used to construct an index from the routine clinical screening data which estimates the level of risk enhancement for the individual potential donors, in relation to the (lowest risk) reference group, and to establish the threshold above which they should be rejected, such that the overall HIV infection risk is diminished, while the collected blood volume is not substantially reduced.

One possibility for constructing such a procedure could be to use the results of the multiple logistic regression and the resulting logit function L(x), where x is the vector of the routine clinical screening variables only, as a quantifier of the *a priori* HIV infection risk. The logit value L(x) may be calculated for each individual in the sample, and then the sample may be ordered (sorted) in increasing value of L. Increasing rank of observations within the ordered

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sample should now correspond to increasing HIV infection risk, and at this point it should be verified if the fraction of HIV infected donors in fact represents a non-decreasing function of rank (more precisely, if the multiple regression model explains adequately the observation data). If one considers a virtual experiment in which the same data are obtained in the order of increasing L, at every point the rank r (cumulative number of blood donors) is proportional to the volume of collected blood, and may be taken here as the "output" variable (which one would like to maximize). Denoting by h(r) the cumulative number of infected donors, the fraction of HIV infected donors h(r)/r may be here taken as the "input" variable (which one would like to minimize), and the efficiency function may then be defined as:

$$E(r) = \frac{r}{h(r)/r} = \frac{r^2}{h(r)} .$$

If the function E(r) has a maximum, this can be interpreted as the point where the "output" (blood volume, proportional to r) is maximized simultaneously with minimizing the "input" (infection risk, proportional to h(r)/r), which therefore justifies the term "efficiency" function for E(r). By rejecting individuals with logit values (calculated from data on clinical screening) above the threshold corresponding to the maximum of the function E(r) (or some other carefully selected criterion), the blood collection process should be optimized in the sense of maximizing the collected blood volume with simultaneous minimization of the HIV infection risk.

This or any other similar potential proposal for optimization of the blood donation process in terms of HIV risk, based on the parameters of a model such as that of Maristone et al.[1] obtained by fitting the observation data, would be of course suitable only for the population from which the sample was drawn. While any such procedure for optimizing the blood collection process may be expected to be applicable for other areas of Brazil with a similar population structure, it should be verified using real data. For other regions, perhaps different independent variables should be taken into consideration in the clinical screening procedure, which may turn out more relevant for the local population.

In conclusion, the work of Maristone et al.[1] addresses an important issue that merits further research. They reach some important conclusions regarding increased risk of HIV infection among blood donors stemming from the peculiarities of the local population, thus paving the way for further future research in the direction of optimization of the blood collection process.

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