Genetically Determined Hazards of Blood Transfusion Within and Between Races*

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SUMMARY

The risks of sensitizing the recipient of a blood transfusion to the antigens on the red blood cells of the donor have been calculated for the various populations of Southern Africa. Although many of these antigens vary markedly in their frequencies in different populations, the theoretical risks of incompatible transfusion with respect to these antigens are small and are of the same order of magnitude whether one is considering inter- or intra-racial transfusion.

There would appear to be no good serogenetic reason for the labelling of containers of human blood with the race of the donor.

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There is in South Africa legislation requiring that the race of the blood donor should be stipulated on every container of human blood.[1] Contrary to widespread belief, however, there is no prohibition of inter-racial blood transfusion. At the time that the regulations were first promulgated, the pathologist responsible for drafting the regulations was reported as having said, 'Though different blood group factors occur in all races, the frequency distribution of these factors varies from race to race. A knowledge of the race of the donor and patient, may be scientifically useful in cross-matching different bloods and may shorten the work of technicians'.[2] The first part of this statement cannot be faulted, but the second part seems to deserve further examination and comment.

In 1960 the American National Academy of Sciences made a statement, pointing out the unsoundness of segregating blood donors on the basis of racial origin,[3] but it was Giblett[4] who presented the first and, as far as we are aware, only critique of the theoretical hazards of inter- versus intra-racial transfusion. She considered the situation which existed in the USA at that time; using the same methods as she did, we have set out to examine the circumstances in Southern Africa. Only two races, Caucasoid and Negro, were considered in the USA; any treatment of the possible dangers of transfusion in Southern Africa should ideally consider the four racial groups designated in the legislation, namely Caucasoid ('Whites'), Coloured, Indian and other Asiatic, and Negro ('Bantu'). The third of these groups is, incidentally, in itself sufficient to preclude any possibility that a truly scientific segregation was intended, as it classifies together the Caucasoids of North India, the putative Caucasoid/Australoid hybrids of South India, and the Mongoloids of further east. For this reason, and owing to our lack of data, we have excluded from consideration those sections of the South African population whose known recent origins are from Asia. Instead, and despite their comparative scarcity, we have considered the Khoisan peoples, nowadays found mainly in Botswana and South West Africa.

The hazards of blood transfusion lie principally in the possibility of recipient reaction to donor blood. This may occur immediately, due to the presence in the serum of the recipient of naturally-occurring antibodies or of iso-antibodies, resulting from previous transfusion or pregnancy; or it may not be clinically perceptible and consist simply in the formation of antibodies against antigens present in the donor blood. Careful cross-matching techniques will in the vast majority of cases prevent the former type of reaction; the latter is much more difficult to avoid. It is patently impossible in practice to ensure that every recipient receives only blood exactly like his own. Whether antibodies against those antigens not routinely tested for in transfusion situations do in fact get produced, depends of course on the immunological state of the recipient and on the antigenicity of each particular blood group substance. As Giblett has pointed out, certain antibodies, such as those against P, M, N, Lu^a, Le^a and Le^b, though they may occur naturally or as a consequence of sensitization, are rarely, if ever, responsible for transfusion reactions due to red cell destruction. By combining data from four different laboratories, she has shown that, of those known to give rise to transfusion problems, anti-K, anti-C and anti-E are the commonest antibodies encountered, followed by those against k, e, Fy^a, c, Jk^a, S, Jk^b and s, in that order. From the same data, she has deduced that about 5% of Kell-negative individuals receiving Kell-positive blood are likely to become sensitized; and from the frequency with which the various antibodies have been encountered in the same laboratories, she has calculated the 'antigenic potency' of the various other antigens, taking that of K as being 0,05 and relating the others to it. Though she does not explicitly say so, 'antigenic potency' appears to consist of the product of the mean ability of each antigen to stimulate antibody production, and the mean immunological susceptibility to the antigen of the individuals exposed to it. She does not, in fact, make any reference to the latter quality, which, it may be argued, has not been established as being invariable among different populations. In the absence of any certain evidence to the contrary however, we consider ourselves

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justified in assuming that it is at least comparable, and we have consequently accepted her figures for the relative potency (*R*) of the antigens as being as applicable to all Southern African, as to American populations. These figures, with respect to the eleven antigens found in America to be the most, or indeed the only, important causes of transfusion reactions apart from ABO and Rhesus D, are set out in Table I.

TABLE I. RELATIVE POTENCY OF ANTIGENS (AFTER GIBLETT[4])

Antigen	Potency	Antigen	Potency
K	0,0500	C	0,0011
c	0,0205	Jk^a	0,0007
E	0,0169	S	0,0004
K	0,0150	Jk^b	0,0003
e	0,0056	s	0,0003
Fy^a	0,0023		

Except perhaps in circumstances to be discussed below, it is presumed that the blood typing required by the legislation would be adequate in preventing all mismatchings in the ABO system, and with regard to D. Equipped with Giblett's basic data and methods, we have therefore examined the situation in Southern Africa.

METHODS AND RESULTS

We have chosen our representative populations from among those on whom the relevant particulars have been determined in the Human Sero-Genetics Unit of the SAIMR. The Pedi, a Bantu-speaking Transvaal people, were selected as representative of the Negro populations of Southern Africa, largely because we have fairly comprehensive data on them. The Caucasoid sample is made up of 124 Johannesburg residents, mainly medical students and staff of the Institute (and including, incidentally, both authors); this group had unfortunately not been typed for the Kidd system, and has therefore been allotted frequencies for the English, taken from Race and Sanger.[5]

A random sample of inhabitants of Coronationville, a settlement near Johannesburg, make up the Coloured sample, representing that hybrid population of whose actual constituents there has lately been so much discussion. The !Kung of Dobe in Botswana were chosen as representative San ('Bushmen'), and a sample of Nama 'Hottentots' from Keetmanshoop in South West Africa, taken as typical of the Khoikhoi. In Table II are presented the proportions of each population phenotypically presenting with or lacking the eleven antigens.

To calculate the probability of exposure, the phenotypic frequency in the donor population is multiplied by the proportion lacking the antigen in the recipient population. For instance, the proportion of San possessing Fy^a is 0,4519, and the proportion of Pedi without it is 0,9065; the probability of exposure to the Fy^a antigen in any random transfusion of San blood into a Pedi, is consequently 0,4519 × 0,9065, or 0,4096. An indication of these probabilities (*P*) in regard to each antigen in the event of transfusions within, or between, all the five populations under consideration is given in Table III.

But the probability of exposure is not the same as the probability of antibody production; to determine that, it is necessary to multiply *P*, the probability of exposure, by *R*, the antigenic potency. Applying this manoeuvre to the example given above, and multiplying 0,4096 by 0,0023, we find that the chance that in the transfusion of San blood into Pedi, an antibody against the Fy^a antigen will be produced is only 0,0009, or about one in a thousand. We are, however, dealing not with one, but with eleven antigens; to find their cumulative likelihood of antibody stimulation, we must first determine the probability of non-immunization by subtracting $R \times P$ from one and multiplying the results of this for each, with the result for every other antigen. Subtraction of this cumulative product from one, will in its turn give

TABLE II. PROPORTION OF EACH OF FIVE POPULATIONS POSSESSING (+) OR LACKING (−) A PARTICULAR ANTIGEN

	Caucasoid*		Pedi		Coloured		San		Khoikhoi	
Antigen	+	−	+	−	+	−	+	−	+	−
C	0,6694	0,3306	0,1558	0,8442	0,4128	0,5872	0,1175	0,8825	0,2157	0,7843
c	0,8306	0,1694	1,0000	0,0000	0,9725	0,0275	1,0000	0,0000	0,9804	0,0196
E	0,2983	0,7017	0,1473	0,8527	0,1651	0,8349	0,0052	0,9948	0,1046	0,8954
e	0,9839	0,0161	0,9943	0,0057	0,9725	0,0275	1,0000	0,0000	0,9935	0,0065
K	0,0887	0,9113	0,0000	1,0000	0,0917	0,9083	0,0000	1,0000	0,0131	0,9867
k	0,9980	0,0020	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000
Fy^a	0,6694	0,3306	0,0935	0,9065	0,4771	0,5229	0,4519	0,5481	0,5098	0,4902
S	0,4758	0,5242	0,4388	0,5612	0,4128	0,5872	0,2752	0,7248	0,4183	0,5817
s	0,9113	0,0887	0,9409	0,0591	0,9450	0,0550	0,9457	0,0543	0,8758	0,1242
Jk^a	0,7715†	0,2285†	0,9713	0,0287	0,9633	0,0367	0,9882	0,0118	0,9997	0,0003
Jk^b	0,7553†	0,2447†	0,3074	0,6926	0,3303	0,6697	0,2118	0,7882	0,1046	0,8954

* Based on the typing of 124 Johannesburg residents, mainly medical students and staff.
† Data from Race and Sanger for English population.[5]

TABLE III. PROBABILITY OF EXPOSURE TO PARTICULAR ANTIGENS ACCORDING TO TYPE OF TRANSFUSION

	Antigen											
Type of transfusion	K	c	E	k	e	Fy^a	C	Jk^a	S	Jk^b	s	Total (x 1 000)
Pedi→Pedi	0,0000	0,0000	0,1256	0,0000	0,0057	0,0848	0,1315	0,0279	0,2463	0,2129	0,0556	0,8953
Pedi→Caucasoid	0,0000	0,1694	0,1034	0,0020	0,0160	0,0309	0,0515	0,2219	0,2300	0,0752	0,0835	0,9838
Pedi→Coloured	0,0000	0,0275	0,1230	0,0000	0,0273	0,0489	0,0915	0,0356	0,2577	0,2059	0,0518	0,8692
Pedi→San	0,0000	0,0000	0,1465	0,0000	0,0000	0,0512	0,1375	0,0115	0,3180	0,2423	0,0511	0,9781
Pedi→Khoikhoi	0,0000	0,0196	0,1319	0,0000	0,0065	0,0458	0,1222	0,0003	0,2552	0,2752	0,1169	0,9736
Caucasoid→Caucasoid	0,0808	0,1407	0,2093	0,0020	0,0158	0,2213	0,2213	0,1763	0,2494	0,1848	0,0808	1,5825
Caucasoid→Pedi	0,0887	0,0000	0,2544	0,0000	0,0056	0,6068	0,5651	0,0221	0,2670	0,5231	0,0539	2,3867
Caucasoid→Coloured	0,0806	0,0228	0,2491	0,0000	0,0271	0,3500	0,3931	0,0283	0,2794	0,5058	0,0501	1,9863
Caucasoid→San	0,0887	0,0000	0,2967	0,0000	0,0000	0,3669	0,5907	0,0091	0,3449	0,5953	0,0495	2,5358
Caucasoid→Khoikhoi	0,0875	0,0163	0,2671	0,0000	0,0064	0,3281	0,5250	0,0002	0,2768	0,6763	0,1132	2,2969
Coloured→Coloured	0,0833	0,0267	0,1378	0,0000	0,0267	0,2495	0,2424	0,0354	0,2424	0,2212	0,0520	1,3174
Coloured→Pedi	0,0917	0,0000	0,1408	0,0000	0,0055	0,4325	0,3485	0,0276	0,2317	0,2288	0,0559	1,5630
Coloured→Caucasoid	0,0836	0,1647	0,1159	0,0020	0,0157	0,1577	0,1365	0,2201	0,2164	0,0808	0,0838	1,2772
Coloured→San	0,0917	0,0000	0,1642	0,0000	0,0000	0,2615	0,3643	0,0114	0,2992	0,2603	0,0513	1,5039
Coloured→Khoikhoi	0,0917	0,0191	0,1478	0,0000	0,0063	0,2339	0,3238	0,0003	0,2401	0,2958	0,1174	1,4762
San→San	0,0000	0,0000	0,0052	0,0000	0,0000	0,2477	0,1037	0,0117	0,1995	0,1669	0,0514	0,7861
San→Pedi	0,0000	0,0000	0,0044	0,0000	0,0057	0,4096	0,0992	0,0284	0,1544	0,1467	0,0559	0,9043
San→Caucasoid	0,0000	0,1694	0,0036	0,0020	0,0161	0,1494	0,0388	0,2258	0,1443	0,0518	0,0839	0,8851
San→Coloured	0,0000	0,0275	0,0043	0,0000	0,0275	0,2363	0,0690	0,0363	0,1616	0,1440	0,0520	0,7585
San→Khoikhoi	0,0000	0,0196	0,0047	0,0000	0,0065	0,2215	0,0922	0,0003	0,1601	0,1896	0,1175	0,8120
Khoikhoi→Khoikhoi	0,0129	0,0192	0,0937	0,0000	0,0065	0,2499	0,1692	0,0003	0,2433	0,0937	0,1088	0,9975
Khoikhoi→Pedi	0,0131	0,0000	0,0892	0,0000	0,0057	0,4621	0,1821	0,0287	0,2347	0,0724	0,0518	1,1398
Khoikhoi→Caucasoid	0,0119	0,1661	0,0734	0,0020	0,0160	0,1685	0,0713	0,2284	0,2193	0,0256	0,0777	1,0502
Khoikhoi→Coloured	0,0000	0,0270	0,0873	0,0000	0,0273	0,2665	0,1267	0,0367	0,2456	0,0711	0,0482	0,9363
Khoikhoi→San	0,0131	0,0000	0,1041	0,0000	0,0000	0,2794	0,1904	0,0118	0,3032	0,0824	0,0476	1,0320

us the total probability that the recipient will be sensitized or stimulated by the blood of the donor to produce one or more antibodies. The probabilities of antibody production by any of the antigens in any type of transfusion among the five populations, the cumulative products of $1\text{-}R \times P$, and the cumulative probabilities of sensitization, are arranged in Table IV.

DISCUSSION

The first and most revealing of the results to be seen in Table IV, is that the calculated risk is greatest when both the donor and the recipient are Caucasoids; it is almost five times as large as that when only Negroes are involved, and exceeds that inherent in the transfusion of Negro blood into a Caucasoid or Caucasoid blood into a Negro. All the risks, however, are small; in all the possible combinations of donor and recipient, the theoretical hazards are in fact of much the same order of magnitude. It would therefore seem that for the various populations of Southern Africa, as was shown to be the case for North American populations, the unavoidable risks of administering incompatible blood transfusions would not be lessened by ensuring only intra-racial transfusions. The marginal reduction to be obtained by giving, for example, Pedi or San or Khoikhoi blood to a Caucasoid in preference to blood from a member of his own race, is hardly worth considering. There are, it is true, three antigens (V, e^s and Js^a), found in those three populations at significant frequencies, while in Caucasoids they hardly occur at all, which are not considered by Giblett; their antigenic potency has not been assessed with any degree of accuracy, and it is just possible that they might increase the chances of sensitization, if Negro or Khoisan blood were administered to Caucasoids; but their intra-racial contribution to transfusion hazards is sufficiently slight to suggest that they might not add significantly to the risks of transfusion between races.

On the other hand, there are other antigens which in certain circumstances might prove dangerous. We feel justified in assuming that all blood-grouping laboratories in South Africa are meticulous in identifying D^u in the Rhesus system and the common weak A variant known as A_{bantu}.[3] There might possibly, however, be situations in which blood was so urgently needed in an out-of-the-way place without all the technical facilities of a proper laboratory, that hasty blood-typing could lead to the identification of A_{bantu} blood as O or, less commonly, A, or that the presence of D^u would not be recognized and the patient or the donor classified as Rhesus-negative. In the former instance, it is to be presumed that compatibility tests would still be carried out, and the possibly disastrous administration of A_{bantu} blood to a group O recipient, or of A blood to a group A_{bantu} patient, be thereby avoided. But the compatibility test will not, unless the recipient has previously been immu-

TABLE IV. PROBABILITY OF STIMULATING ANTIBODY FORMATION ACCORDING TO TYPE OF TRANSFUSION (i.e. $R \times P$, SEE TEXT FOR EXPLANATION)

Type of transfusion	Antigen											Cumulative product of $(1-P) \times R^*$	1-cumulative product
	K	c	E	k	e	Fy[a]	C	Jk[a]	S	Jk[b]	s		
Pedi→Pedi	0,000000	0,000000	0,002123	0,000000	0,000032	0,000195	0,000145	0,000020	0,000099	0,000064	0,000017	0,997308	0,002692
Pedi→Caucasoid	0,000000	0,003473	0,001747	0,000030	0,000090	0,000071	0,000057	0,000155	0,000092	0,000023	0,000025	0,994247	0,005753
Pedi→Coloured	0,000000	0,000564	0,002078	0,000000	0,000153	0,000112	0,000101	0,000025	0,000103	0,000062	0,000016	0,996789	0,003211
Pedi→San	0,000000	0,000000	0,002475	0,000000	0,000000	0,000118	0,000151	0,000008	0,000127	0,000073	0,000015	0,997033	0,002967
Pedi→Khoikhoi	0,000000	0,000402	0,002229	0,000030	0,000036	0,000105	0,000134	0,000000	0,000102	0,000083	0,000035	0,996875	0,003125
Caucasian→Caucasoid	0,004040	0,002884	0,003537	0,000030	0,000088	0,000509	0,000243	0,000123	0,000100	0,000055	0,000024	0,988414	0,011586
Caucasian→Pedi	0,004435	0,000000	0,004299	0,000000	0,000031	0,001396	0,000622	0,000015	0,000107	0,000157	0,000016	0,988963	0,011037
Caucasian→Coloured	0,004028	0,000468	0,004209	0,000000	0,000152	0,000805	0,000432	0,000020	0,000112	0,000152	0,000015	0,989644	0,010356
Caucasian→San	0,004435	0,000000	0,005014	0,000000	0,000000	0,000844	0,000650	0,000006	0,000138	0,000018	0,000015	0,988760	0,011240
Caucasian→Khoikhoi	0,004375	0,000334	0,004514	0,000000	0,000036	0,000755	0,000578	0,000000	0,000111	0,000203	0,000034	0,989101	0,010899
Coloured→Coloured	0,004165	0,000548	0,002323	0,000000	0,000150	0,000574	0,000267	0,000025	0,000097	0,000066	0,000016	0,991792	0,008208
Coloured→Pedi	0,004585	0,000000	0,002379	0,000000	0,000031	0,000995	0,000383	0,000019	0,000093	0,000069	0,000017	0,991452	0,008548
Coloured→Caucasoid	0,004178	0,003377	0,001958	0,000030	0,000088	0,000363	0,000150	0,000154	0,000087	0,000024	0,000025	0,989604	0,010396
Coloured→San	0,004585	0,000000	0,002775	0,000000	0,000000	0,000601	0,000401	0,000008	0,000120	0,000078	0,000015	0,991439	0,008561
Coloured→Khoikhoi	0,004585	0,000392	0,002498	0,000000	0,000035	0,000538	0,000356	0,000000	0,000096	0,000089	0,000035	0,991399	0,008601
San→San	0,000000	0,000000	0,000088	0,000000	0,000000	0,000570	0,000114	0,000008	0,000080	0,000050	0,000015	0,999075	0,000925
San→Pedi	0,000000	0,000000	0,000074	0,000000	0,000032	0,000942	0,000109	0,000020	0,000062	0,000044	0,000017	0,998701	0,001299
San→Caucasoid	0,000000	0,003472	0,000061	0,000030	0,000090	0,000344	0,000043	0,000158	0,000058	0,000016	0,000025	0,995707	0,004293
San→Coloured	0,000000	0,000564	0,000073	0,000000	0,000154	0,000543	0,000076	0,000025	0,000065	0,000043	0,000016	0,998442	0,001558
San→Khoikhoi	0,000000	0,000402	0,000079	0,000000	0,000036	0,000509	0,000101	0,000000	0,000064	0,000057	0,000035	0,998716	0,001284
Khoikhoi→Khoikhoi	0,000645	0,000391	0,001583	0,000000	0,000036	0,000575	0,000186	0,000000	0,000097	0,000028	0,000033	0,996427	0,003573
Khoikhoi→Pedi	0,000655	0,000000	0,001507	0,000000	0,000032	0,001063	0,000200	0,000020	0,000094	0,000022	0,000016	0,996396	0,003604
Khoikhoi→Caucasoid	0,000595	0,003405	0,001240	0,000030	0,000090	0,000388	0,000078	0,000160	0,000088	0,000008	0,000023	0,993907	0,006093
Khoikhoi→Coloured	0,000000	0,000554	0,001475	0,000000	0,000153	0,000613	0,000139	0,000026	0,000098	0,000021	0,000015	0,996910	0,003090
Khoikhoi→San	0,000655	0,000000	0,001759	0,000000	0,0000000	0,000643	0,000209	0,000008	0,000121	0,000025	0,000014	0,996569	0,003431

* P is the probability of exposure to an individual antigen and the individual figures are shown in Table II.
R is the relative potency of the antigen. Estimates of these are shown in Table I.

nized against D, prevent the administration of D^u blood to a Rhesus-negative patient; even in the event of previous immunization, the incompatibility is unlikely to be obvious on saline cross-matching, and will only show up if Coombs testing, or incubation in a high-protein medium, is also performed.

D^u is rather commoner among the non-Caucasoids of Southern Africa than among Caucasoids anywhere, and the hazards of inter-racial transfusion might be supposed to be increased by its presence. For this reason, we have attempted to make a very empirical estimate of the maximum extent to which it might be expected to contribute to the risk. It is difficult to assess the antigenic potency of D^u, and it has consequently not been included in the earlier probability calculations; but it is not likely to exceed 0,20, the proportion of sensitization obtained by van Loghem[7] after repeated administrations of blood containing D^u to an admittedly very small series of Rhesus-negative volunteers, and that is the factor which we have used in preparing Table V, in which the greatest possible contribution D^u is likely to make to the hazards of inter- and intra-racial blood transfusions in Southern Africa is estimated, and a revised set of cumulative and total probablities are calculated.

It will be seen that there is a small rise in probability of reaction in all the combinations of donor and recipient, the steepest being in the transfusion of Coloured blood into Caucasoids, which now appears marginally (0,012769 as against 0,011819) more dangerous than that of Caucasoid to Caucasoid. San blood is still 'safer' than any other for a recipient of any race; but the differences among the combinations are still negligible.

Consideration of dangers resulting from the presence of the Australia antigen in donor blood does not fall strictly within the scope of the present study. It has certainly been established that it is much more commonly found in the blood of Southern African Negroes and of San, than in that of Caucasoids;[7-9] but it is obviously desirable that all blood donated should be screened for the presence of the antigen, and it is understood that legislation to ensure this is contemplated. Until such legislation has been promulgated, or until screening is adopted as a routine in all relevant laboratories, it will continue to add to the hazards of transfusion. It should rather, though, be counted as an infective hazard, with its determination on a par with the routine exclusion of the possibility of the transfer of other infective agents: in which case it is no more relevant to our contentions, than are transient viraemias, bacteraemias or malaria.

It might still be argued that there are serological situations in which 'a knowledge of the race of the donor and patient may be scientifically useful in cross-matching different bloods'. It can be seen from Table II that in the presence of, for instance, a proven anti-K in the serum of the recipient, any random Caucasoid blood of the same ABO and Rhesus groups carries a one in twelve probability of possessing K antigen, whereas with Negro or San blood the probability is negligible. A well-informed cross-matcher might consequently save himself some time and trouble by selecting only San or Negro blood for cross-matching. But the probability of the occurrence of this situation, or an analogous one involving some other antigen more commonly found in one race than another, is itself slight, and scarcely seems to justify the making of the statement. It seems very probable that at the time the regulations were

TABLE V. PROBABLE CONTRIBUTION OF THE ANTIGEN D^u TO THE STIMULATION OF ANTIBODY FORMATION, AND ITS EFFECT ON THE CUMULATIVE PROBABILITY

Donor populations	Recipient populations				
	Pedi	Caucasoid	Coloured	San	Khoikhoi
Pedi					
Contribution of D^u	0,000051	0,000382	0,000021	0,000060	0,000000
Cumulative product	0,997257	0,993921	0,996768	0,996973	0,996875
1-cumulative product	0,002743	0,006079	0,003232	0,003027	0,003125
Caucasoid					
Contribution of D^u	0,000037	0,000235	0,000015	0,000040	0,000000
Cumulative product	0,988927	0,988182	0,989629	0,988720	0,989101
1-cumulative product	0,011073	0,011819	0,010371	0,011280	0,010899
Coloured					
Contribution of D^u	0,000375	0,002398	0,000150	0,000380	0,000000
Cumulative product	0,990080	0,987231	0,991641	0,991062	0,991399
1-cumulative product	0,008920	0,012769	0,008359	0,008938	0,008601
San					
Contribution of D^u	0,000080	0,000460	0,000020	0,000080	0,000000
Cumulative product	0,998621	0,995249	0,998422	0,998995	0,998716
1-cumulative product	0,001379	0,004751	0,001578	0,001005	0,001284
Khoikhoi					
Contribution of D^u	0,000140	0,000940	0,000060	0,000160	0,000000
Cumulative product	0,996257	0,992973	0,996850	0,996410	0,996427
1-cumulative product	0,003743	0,007027	0,003150	0,003590	0,003573

promulgated, the pathologist who drafted these was not aware of the American results; we hope that the demonstration of similar results in a Southern African context will put to rest the apprehensions sometimes expressed about the hazards of inter-racial blood transfusion.

We consider that we have established that there is no serogenetic reason for the labelling of containers of human blood with the race of the donor.

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