Clinical practice

Benefits of HIV screening of blood transfusions in Zambia

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Summary

Blood transfusion continues to be an important route of transmission of HIV in developing countries, especially for young children following the perinatal period. Testing for HIV is costly and reliable donor support for the purchase of test kits is often essential, yet difficult to secure. The costs of screening of transfusions for HIV and the financial benefits in terms of savings on treatment costs averted were calculated for a district hospital in Zambia where seroprevalence among donors was 15·9%.

Financial benefits exceed costs by a factor of 2·7–3·5. In 1991, 1073 transfusions were given and an estimated 150 cases of transfusion-related AIDS were prevented by screening, of which 59% were in children aged 5 years or under and 31% were in women. The total cost of HIV screening was £3061 ($4745), and the cost per case of HIV infection prevented was £20·40 ($31·62); the cost of this protection for the population served by the hospital was £0·02 ($0·03) per person. An estimated 3625 undiscounted healthy years of life were saved, of which nearly 69% were in children under 6, at a cost of £0·85 ($1·32) per year of life saved.

It is essential that financial and political support for HIV screening of blood for transfusion is maintained.

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Introduction

In the developing countries, HIV transmission via blood transfusion still accounts for about 5–10% of all infections.[1] After transfusion of an HIV-infected unit the risk of infection is 95–100%,[2] although rates of seroconversion as low as 90% have been reported.[3] The blood transfusion service is one of the most expensive parts of most health systems. Adequate and stable financing is a prerequisite for success of a transfusion service,[2] yet many developing countries with high rates of HIV infection are dependent on donor funding for the screening of blood for transfusions, as well as for other key aspects of the prevention and control of AIDS. The cost of the HIV testing and the perception that blood transfusion is an unimportant route of HIV transmission threaten to lead to a decline in support for this essential activity. Aid donors often prefer to invest in prevention in terms of health education and behaviour change. However, although transfusions are a minor route of transmission overall, for children aged 1–15 years they are a major source of largely preventable exposure to HIV. Doubts are sometimes expressed as to the cost-effectiveness of blood screening compared with other interventions. Whereas it is not possible to compare directly the cost-effectiveness of blood screening with other interventions due to the lack of information on the effectiveness of the other interventions,[4] it is nonetheless possible to examine the costs and benefits of screening blood for HIV. We have done so with data gathered at Monze District Hospital, Zambia.

Blood transfusion at Monze Hospital

Monze Hospital is a 250-bed hospital located in the southern province of Zambia. In 1991 overall seroprevalence of HIV was about 15·9% (table 1) among the hospital's blood donors and "replacement donors" recruited from among the relatives and friends of patients requiring transfusion.[5] Many more men than women donate blood, possibly because many women are pregnant or lactating and therefore ineligible to donate, or are excluded on the basis of low haemoglobin concentrations.

Age group	Male		Female	
	Number in age group	% HIV +ve	Number in age group	% HIV +ve
10–19	104	1·0	25	8·0
20–29	561	15·4	73	31·5
30–39	301	21·9	36	11·1
40–49	141	26·2	27	3·7
50–69	61	7	11	9
Age unknown	2	0	0	0
Total	1170	15·6	172	18·0

Table 1: **HIV seroprevalence among blood donors by age and sex**

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Efforts are made to minimise use of transfusions, with an average of 1·45 units per adult. Children aged 5 or under receive half or sometimes a third of a unit. All blood collection and testing is done in the hospital's own laboratory because there is no centralised blood transfusion service in Zambia for the rural areas. Blood donors are usually the relatives of the patient who needs the transfusion. The usual procedure is to interview and weigh the donor, measure his or her haemoglobin concentration, and then to collect the blood. Blood is tested for HIV with HIVChek (HIVChek 1 & 2, DuPont de Nemar's, Geneva, Switzerland) or another rapid test when available, or by ELISA when not. Blood is usually collected before the HIV result is available. During the interview the donor is asked questions on travel abroad, occupation, visits to bars, and previous sexually transmitted diseases, but this information is not used to reject donors.

The cost of testing is dependent on which HIV test is available at the time. A rapid test such as HIVChek is preferred because individual units can be tested, but the price is high. The alternative is an ELISA such as the Wellcozyme ELISA (Wellcozyme HIV 1 & 2, Wellcome Diagnostics, Dartford, UK), which is cheaper but which cannot be read immediately. Blood donors in Monze are not told their HIV results, so no counselling is provided either before or after the test, and accordingly our costs do not include costs of counselling or of any confirmatory tests that would be required if the donor were to be informed. Furthermore, we do not take account of any benefits that might accrue to blood donors from knowledge of their HIV status in terms of impact on behaviour or early treatment or prophylaxis of HIV-related conditions. If a rapid test is not available, blood is collected and stored until it can be tested by ELISA. The total cost of collection of 1 unit of blood is £7·59 (about $11·76) when HIVChek is used, of which the cost of HIVChek amounts to 37·5% of the total; when ELISA is used, the cost of 1 unit is £6·25 ($9·69) and the cost of the test falls to 24% of the total.

The costs of the programme of screening blood for HIV at Monze Hospital can thus be estimated. For the 1073 units transfused in 1991, 1276 units had to be tested and 203 were rejected. In practice, a combination of HIVChek and ELISA (Wellcozyme) was used, with about two-thirds of units screened by HIVChek and one-third by ELISA. The approximate cost of blood collection was £9115 ($14 128), of which HIV tests accounted for £3061 ($4745), 33·6% of the total. As noted above, about 16% of units are discarded because of HIV positivity and the costs of this wastage brings the total cost per usable unit to an average of £8·27 ($12·82).

Cost per infection prevented

If blood had been not screened for HIV, 203 units of HIV-infected blood would have been transfused in Monze Hospital in 1991. However, a significant percentage of the inpatients receiving blood transfusions are already HIV seropositive, so these should be subtracted from the total number of cases prevented. On male and female wards the percentage of HIV-infected patients was about 44%, on the tuberculosis ward 75%, and on the labour ward about 25%. Data on seroprevalence are not available for the children's ward, so an estimate of 10% is used. This estimate is based on the assumption that almost all HIV-positive children under 6 will have been infected perinatally. About 25% of women in the maternity ward and female blood donors aged 20–39 are HIV seropositive. If about 39% of their children are infected perinatally,[6] that would imply a seroprevalence of about 10% among young children.

Ward	Units issued to ward	Infected units not issued*	Mean units per patient	Infections potentially prevented	Estimated HIV sero-prevalence (%)†	Infections actually prevented (% of total infections prevented)‡
Male	158	32	1·45	22	44	12 (8)
Female	307	54	1·45	37	44	20 (13)
Children's	252	49	0·50	98	10	88 (59)
Tuberculosis	31	5	1·45	3	75	1 (1)
Maternity	299	59	1·45	40	25	27 (18)
Other/ unspecified§	26	5	1·45	3	20	2 (1)
Total	1073	203	0	203		150 (100)

*Assuming the 203 screened and rejected units would have been distributed and transfused in the same proportions as uninfected units. †Source: ADZAM (adult disease in Zambia) data, Monze Hospital, 1991. ‡Assumes infectious window period transfusions were used by children's ward (3 units) and maternity (3 units) (see text). §Assumes other/unspecified units were used by adults.

Table 2: **Number of transfusion-related HIV infections prevented by blood screening**

Screening will not prevent all HIV transmission because of the likelihood of false negatives, in particular when the donor is in the "window" period and has not yet seroconverted.[7] Savarit et al[8] estimated that in Abidjan, Ivory Coast, in 1991 the overall rate of potentially infected units (units that had been screened but which were nonetheless still infectious) was between 5·4 and 10·6 per 1000; in their sample, seroprevalence was 11·0% in first-time donors and 2·1% in repeat donors, considerably lower rates than those found in Monze. From the higher value of 10·6 per 1000, we can estimate that despite screening, a minimum of 11·4 of the 1073 units transfused were probably infected but were not detected by screening. Of these—given that about 30% of recipients are already seropositive—about 8 units would have caused new infections. If we assume the distribution of units described in table 2, these units would have caused three infections in children and three infections in adults. Therefore, 150 infections were prevented by screening, and the cost of HIV screening per infection prevented was £20·40 ($31·62) Table 2 shows that about 59% of infections prevented would have been in children aged 5 or under and 31% in women.

Monze Hospital serves a rural population of about 150 000, and about 30% of its inpatients are drawn from outside the district. Screening of blood for HIV infection is, therefore, protecting about 200 000 people who might receive a transfusion in the hospital. The cost of HIV screening was £3061 ($4745), an annual expenditure of £0·02 ($0·03) per person.

Benefits of HIV screening of blood

We estimated the number of years of healthy life saved by blood screening in 1991. Assuming, conservatively, that only half of those protected who did not already have HIV infection when in hospital would live out their normal life expectancy—ie, would not die of the illness for which they received a transfusion and would not succumb to HIV later in life—the number of years of life saved can be calculated (table 3). Taking account of infections caused by screened but infectious units, the undiscounted

Ward	Infections prevented (% total infections prevented)*	Mean age of patients†	Years of life saved/ person†	Total years saved per ward (% of total years saved)‡
Male	12 (8)	36·9	33·2	199 (5·5)
Female	20 (13)	34·9	32·7	327 (9·0)
Children's	88 (59)	3·0	56·4	2482 (68·5)
Tuberculosis	1 (1)	35·9	32·9	33 (0·9)
Maternity	27 (18)	24·4	40·8	551 (15·2)
Other§	2 (1)	35·0	32·9	33 (0·9)
Total	150 (100)	..	..	3625 (100)

*Window period infections subtracted from children's ward (3) and maternity ward (3). †Calculated from an appropriate model life table for eastern Africa fitted to the Zambian under-5 mortality rate of 177·5 (World Bank Social Indicators of Development, 1994). ‡Assuming only half of transfusion recipients live out their normal life expectancy. §Assumed to be adults.

Table 3: **Undiscounted years of healthy life saved by blood screening for HIV**

number of years saved is about 3625 of which 68·5% are years of life of children under 6. The cost of HIV screening at this hospital per year of healthy life saved is £0·85 ($1·32).

We also estimated the financial savings from preventing HIV infection. Our study gathered data on the costs of treatment for HIV disease in inpatient wards and the outpatient department. We estimated that the cost to the health services of treating HIV disease in the 2 years before death was about £72 ($110·60) per person. Treatment of the 150 AIDS cases that would have been caused in 1991 by transfusion of unscreened blood would have cost £10 800 ($16 740); these are the undiscounted financial savings from screening. The cost of screening blood in 1991 was estimated at £3061 ($4745). Thus, the benefit/cost ratio (BCR) is 3·5/1. Given that most of the benefits will be incurred in the future, it is appropriate to examine the effect of discounting those benefits. The resulting BCRs from progression rates of 5% and 8% and a discount rate of 3% are 2·7/1 and 3·0/1, respectively. BCRs would be higher at higher levels of donor seroprevalence: at 20% the undiscounted BCR is more than 4·0/1. At seroprevalence levels below about 3% the BCR becomes less than 1—ie, costs exceed savings as defined above, but the cost per life saved remains low.

Discussion

We have shown that HIV screening of blood for transfusion has financial benefit in areas with high seroprevalence among blood donors. Under plausible conditions, at seroprevalence among donors of about 16%, savings from blood screening exceed costs of screening by a factor of between 2·7 and 3·5. We have chosen a narrow definition of the benefits of screening as the financial savings to the health services of not having to treat HIV disease that would otherwise have been caused. This approach does not take account of the other advantages of preventing a case of HIV disease and a death from AIDS—eg, no pain and suffering, loss of income, lost productivity, and disruption to the household. Over[9] estimated that such indirect costs made up 83–99% of the total costs of a case of AIDS. The annual cost of screening per person protected of £0·02 ($0·03) compares favourably to other methods of HIV prevention. Condoms in Zaire and Ivory Coast cost £0·07 ($0·11) and £0·10 ($0·16) each, respectively; assuming a low rate of usage of one condom per month, the annual cost of such protection for two partners at a time would be £0·84–1·20 ($1·3–1·86). Costs of treatment of sexually transmitted diseases to reduce HIV transmission range from £6·30 to £37 ($9·77 to $57·35) in Mozambique, South Africa, and Kenya.[10]

The risks of transfusion could be reduced by better selection of donors, and, in particular, by a more systematic effort to recruit low-risk volunteer donors. Older people and male adolescents might be more suitable donors, as might religious communities. In Monze, one possibility might be to make use of women's groups or church groups where older women are well represented.

Blood screening will not prevent all transfusion-related cases of HIV infection, and this point emphasises the need to reduce transfusions to the absolute minimum, or to use blood substitutes, plasma expanders, and autologous transfusion wherever possible. Elsewhere[11] it has been shown that many transfusions are unnecessary, and it is possible that despite attempts to reduce use, some transfusions of limited value are still occurring. However, on male, female, and tuberculosis wards at Monze Hospital, only 50% of transfusions ordered seem to have been given.

Our findings clearly demonstrate that blood screening is a child health issue. 59% of those protected, and nearly 69% of the healthy years of life saved by blood screening are years to be lived by children under 6. HIV screening of blood donations is thus a paediatric priority as well as a good economic choice for countries with high rates of HIV seroprevalence among blood donors. It is essential that financial and political support for blood screening for transfusion is maintained.

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