

# Evaluation of blood bank practices in Karachi, Pakistan, and the government's response

Stephen Luby, Maliha Zia, Zuleikha Vellani, Mohsin Ali, Abdul Haleem Qureshi, Aamir J. Khan ( Community Health Sciences Department, Aga Khan University, Karachi. )

Rafique Khanani ( Sindh Medical College, Karachi. )

Syed Abdul Mujeeb ( Civil Hospital, Karachi, Blood Transfusion Services, Jinnah Post-Graduate Medical Center, Karachi. )

Sharaf Ali Shah ( Sindh AIDS Control Program, Karachi. )

Susan Fisher-Hoch ( Pathology Department, Aga Khan University, Karachi, Pakistan. )

November, 2006

**Background:** National legislation in Pakistan regulating blood banks has been introduced several times, but has never been passed. To support provincial-level efforts to develop legislation we conducted a study to evaluate blood-banking practices in Karachi, Pakistan, to identify areas that could be improved.

**Methods:** Thirty-seven blood banks were randomly selected from a list of 87 Karachi blood banks. The research team interviewed blood bank personnel, inspected available facilities and equipment, and observed blood collection using structured questionnaires and observation forms.

**Results:** Of the 37 selected facilities, 25 were operational and 24 agreed to participate. Twelve (50%) of the facilities reported regularly utilizing paid blood donors, while only six (25%) actively recruited volunteer donors. During observation only 8% of facilities asked donors about injecting drug use, and none asked donors any questions about high-risk sexual behaviour. While 95% of blood banks had appropriate equipment and reagents to screen for hepatitis B, only 55% could screen for HIV and 23% for hepatitis C. Twenty-nine percent of the facilities were storing blood products outside the WHO recommended temperature limits.

**Implications:** Practices at most Karachi blood banks fell well below WHO standards. Findings from this study were instrumental in developing and passing legislation to regulate blood transfusion throughout Sindh Province, and suggest a method for improving blood transfusion practices in other developing countries.

## Introduction

Persons living in developing countries are commonly anaemic,<sup>1</sup> and are at high risk for traumatic injuries and obstetric complications.<sup>2</sup> Blood transfusion in these settings can be life saving. But blood transfusion can also be dangerous. If blood is not accurately typed, fatal cross-reactions may occur. If blood is not collected and stored properly, transfusion can result in overwhelming bacterial sepsis. Blood transfusions can also transmit a host of potentially deadly blood-borne pathogens, including hepatitis B virus (HBV), human immunodeficiency virus (HIV),<sup>3</sup> and hepatitis C virus (HCV).<sup>4</sup> Although most of the world's population lives in developing countries, there is little information available on blood transfusion practices in these settings. The limited available information suggests that practices are not in accordance with international guidelines for safe blood transfusions.<sup>5-7</sup> For example, Lackritz et. al. described a complicated system in a Kenyan hospital, with overreliance on family donors, which caused substantial delays and ultimately resulted in 47% of the transfusions being inappropriate.<sup>8</sup>

The dangers of blood transfusions are compounded by poverty. The requirements for a safe transfusion include organized infrastructure, a Continuous supply of electricity, well-educated professionals, and

readily available supplies of expensive equipment and reagents, resources that are all typically in short supply in developing countries.

Pakistan is a developing country with an estimated infant mortality rate of 89 per 1000 live births and an adult female literacy rate of 23%. It ranks 134th out of the 174 countries on the human development index of the United Nations.<sup>9</sup> Karachi, Pakistan's largest city and economic hub, has an estimated population of 9.8 million people and is situated in Pakistan's Sindh province (estimated population 40 million).

The prevalence of blood-borne hepatitis virus infection is quite high in Pakistan.<sup>10,11</sup> Karachi health care practitioners and Sindh government officials became increasingly concerned that unregulated blood bank facilities in Karachi were unsafe. Despite being introduced several times in the preceding 5 years, attempts to pass national legislation regulating blood banks failed to complete the long legislative approval process. We conducted a study to evaluate blood-banking practices in Karachi, to identify areas that needed improvement, and to provide information to guide provincial authorities in implementing legislation to improve the system.

## Methods

Since there was no official list of blood banks in Karachi, a physician associated with two of the largest government hospitals and the owner of a well-reputed blood bank, drafted an unofficial list of 87 Karachi blood banks. He drew up this list for his own reference using information from personal contacts and his own experience in blood banking in Karachi. He believed this list to be complete and shared it with the study team. The team randomly selected a sample of 37 facilities from the list, and in October and November 1995, visited each of the facilities. They interviewed the most senior administrator and a phlebotomist or technician at the facility using a structured questionnaire. Team members also observed the donor evaluation, blood collection, and screening practices actually being carried out. They recorded their observations on a standardized 50-item observation form. Because many of the facilities collected only a few units in a day, observations of blood screening and handling practices were conducted at fewer facilities ( $n = 13$ ) than the total number of evaluated blood banks ( $n = 24$ ). In addition administrators and/or phlebotomists occasionally refused to answer specific questions. We calculated the prevalence of specific responses using the number of blood banks that provided a response as the denominator.

We evaluated the blood banks using World Health Organization (WHO) standards for safe blood transfusion services.<sup>12</sup> Study staff asked whether blood banks had physicians on staff and whether the medical director had specific training in blood transfusion services. We conceptualized blood screening as a three-tiered process:

first, whether donors were volunteers or paid; secondly, whether a potential donor was a suitable donor by WHO standards based on medical history and physical examination; and thirdly, after blood collection, whether appropriate laboratory studies were performed to detect infectious pathogens. We evaluated each blood bank at each of these levels. We also evaluated whether blood banks produced only whole blood or whether they utilized component therapy as advocated by WHO. Fieldworkers observed the blood storage refrigerators, and noted the temperature on the refrigerator's thermometer. They reviewed the written records of the previous donations and noted how many units of blood were transfused in the preceding week, and what percentage of the preceding 50 units had been transfused by paid donors.

In order to extrapolate data for the whole of Karachi we assumed that the randomly selected facilities which we approached were similar to the facilities on the physician's original list that we did not approach, and that the week prior to the visit was a typical week for blood demand.

## Results

Of the 37 facilities included in the random sample, 3 were mentioned twice by different names, 4 had closed completely, 3 had discontinued their blood transfusion services, 2 could not be located despite extensive inquiries and mobilization of contacts, and one facility refused to participate in the study. The remaining 24 facilities met our inclusion criteria and were included in the study, though in one facility we were not allowed to interview the staff and in a different facility we were not allowed to observe practices. Four of these facilities (17%) were run entirely by the government; 18 (75%) were private organizations, and 2 (8%) were partly financed by the government and partly by private organizations. Twenty-three percent of the blood banks were affiliated with a hospital to which they supplied blood. The others had no formal affiliations and functioned as independent units. At 9 facilities (41%) blood was transfused on site. In the others blood was collected and dispensed, but not transfused. Seventeen of the facilities (74%) provided a 24-hour blood transfusion service.

The most senior administrator was a non-physician in 4 (21%) of the blood banks. Two blood banks (9%) employed no physicians at all. Only 10 of the blood banks (53%) were headed by a qualified hematologist or a pathologist with specialized training in blood transfusion. At 12 facilities (57%) the phlebotomist had acquired a Bachelor's degree, and at 19 facilities (83%) the phlebotomists had received basic technician training.

Twelve of the facilities (50%) reported regularly utilizing paid blood donors. Among the 17 facilities which permitted us to review the preceding 50 units of blood dispensed, 31% of the units were from paid donors. Twenty-one of the facilities (91%) requested that transfusion recipients bring a donor with them, i.e. a replacement donor. Only 9 (39%) of the facilities regularly collected blood from volunteer donors, and only 6 (25%) actively recruited volunteer donors through regular blood collection campaigns.

Blood bank personnel reported some efforts to identify whether a prospective donor was suitable based on their medical history and risk assessment (Table 1).

Table 1. Deferral criteria for blood donation reported and observed at a random sample of Karachi blood banks, 1995.

Deferral criteria	No. (%) of blood banks reporting to use this criteria (n=21)	No. (%) of blood banks observed to be asking donors these questions (n=12)
<b>Risk factors from clinical history</b>		
Jaundice in the past year	13 (62)	10 (83)
Blood donation in last month	2 (10)	5 (41)
Injecting drug use	3 (14)	1 (8)
Multiple sexual partners	0 (0)	0 (0)
Untreated sexually transmitted disease	1 (5)	1 (8)
Acute disease	11 (52)	5 (42)
Chronic disease	6 (29)	6 (50)
Blood transfusion	1 (5)	1 (8)
<b>Physical examination</b>		
	No. (%) reporting using these criteria (n=21)	No. (%) observed to evaluate these criteria (n=12)
Abnormal blood pressure	10 (48)	3 (25)
Under weight	5 (24)	2 (17)
Jaundice	2 (10)	2 (17)
Needle marks	2 (10)	0 (0)
<b>Laboratory blood screening</b>		
	No. reported screening/ No. asked (%)	No. (%) observed with equipment and reagents (n=22)
Hepatitis B surface antigen	21/22 (95)	21 (95)
HIV antibody	12/23 (52)	12 (55)
Hepatitis C antibody	4/23 (17)	5 (23)

However, with the exception of history of jaundice in the last year, deferral criteria were assessed in only a minority of cases. Only 8% asked about injecting drug use, and none asked any questions about high-risk sexual behaviour. Similarly, 87% of facilities reported that a physical examination was performed on all prospective blood donors, but this procedure was observed in only 25% of the facilities. For laboratory screening, 95% of blood banks had appropriate equipment and reagents to screen for hepatitis B, 55% for HIV and 23% for hepatitis C (Table 1). On observation, two of the facilities were pooling specimens prior to testing them for HIV and two were pooling specimens to screen for hepatitis C. Although not a part of the structured questionnaire, respondents at 25% of the facilities spontaneously reported that even when they had equipment and reagents, they did not screen every unit of blood for infectious agents, but did so selectively. This selection was usually dependent upon the recipient's willingness to pay for the costs of the screening tests.

Whole blood was dispensed from all of the facilities, packed cells from 16 (70%), fresh frozen plasma from 10 (43%), platelets from 7 (30%), and cryoprecipitates from 5 (22%). Six of the blood banks (26%) offered only whole blood. Eighty-three percent of blood banks (15/18), including 63% (10/16) of the blood banks dispensing components, collected their blood products in a single bag, rather than into multiple bags to ensure aseptic separation of blood products as recommended by WHO.<sup>12</sup> All of the facilities had a refrigerator.

At the time of inspection the temperature of the refrigerators was outside the WHO recommended limits in 29% of the facilities (Figure).

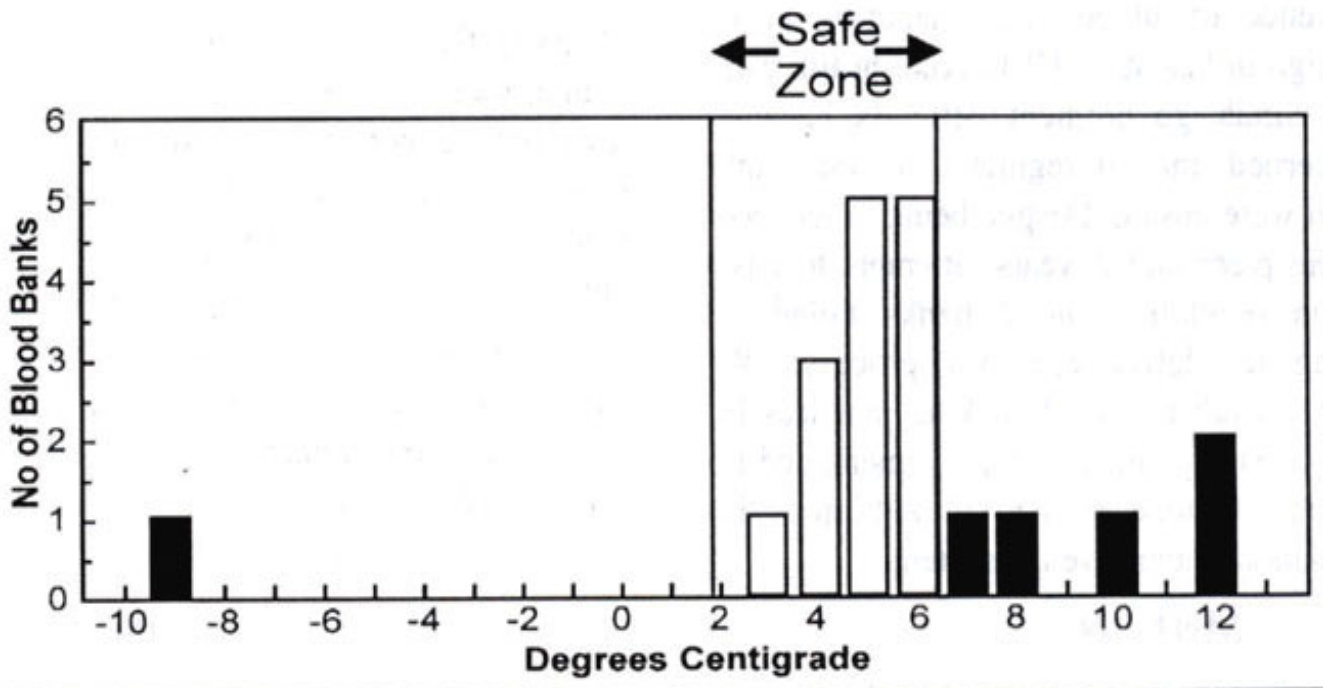


Figure. Temperature of blood storage refrigerators in Karachi blood banks, 1995

On average 50 units were dispensed from each of the facilities in Karachi in the week prior to the study team's visit (range 2-490). Sixty-five percent of blood banks distributed fewer than 20 units of blood in the week preceding the study visit. The observed weekly rate extrapolates to 2950 units of blood transfused in an average week or 153 400 units in a year in Karachi. Most of the blood was transfused in hospitals, with obstetric and surgical units being the most common users (Table 2).

**Table 2. Blood transfusion setting, Karachi 1995.**

	Number (%) <sup>a</sup>
<b>Facility type<sup>b</sup></b>	
Private hospitals	442 (49)
Government hospitals	292 (33)
Maternity homes	96 (11)
General practitioner clinics	8 (1)
Other	60 (7)
<b>Hospital ward<sup>c</sup></b>	
Obstetrics and gynaecology	86 (44)
Surgery	47 (24)
Emergency 24 (12)	
Haematology/Oncology	5 (3)
Other wards	32 (16)

<sup>a</sup> Percentages do not add up to 100% because of rounding.

<sup>b</sup> Includes data from the last 50 donations from the 21 facilities that permitted the study team to review their records (=898).

<sup>c</sup> Includes those 194 transfusions that took place in hospitals where the ward was noted in the register.

Combining maternity homes, which are freestanding inpatient facilities where many women deliver and inpatient obstetric and gynaecology wards accounts for 33% of transfusions. On average one unit of Rh-positive blood cost 452 rupees (US\$13.29) with Rh-negative blood selling at a mean 509 rupees (US\$14.97). This compares with an average urban household monthly income within Pakistan of US\$90.<sup>13</sup>

## Discussion

Practices at most blood banks in Karachi during this study fell well below WHO standards. The WHO recommends organized efforts to recruit voluntary non-remunerated donors as the cornerstone of a safe blood supply.<sup>12</sup> Donors should be screened with a careful history and appropriate laboratory screening tests on each unit of blood.<sup>12</sup> In Karachi 50% of facilities regularly employed paid donors and only 25% regularly organized efforts to recruit volunteer donors. During pre-donation interviews, a history of high-risk behaviour was asked of only a small minority of donors, and laboratory equipment for screening for the major blood pathogens was present in only a minority of facilities. The WHO recommends that transfusion facilities have a doctor available and the medical director of the service has specialized training in blood transfusion.<sup>12</sup> In Karachi, barely half (54%) of blood banks met this standard. The WHO encourages component therapy and storage at safe temperatures to efficiently utilize scarce blood supplies.<sup>12</sup> In Karachi blood banks, blood was not collected for component therapy in the majority of facilities, and a third of facilities held blood products at unsafe temperatures. This failure to meet standard safety practices would be expected to have substantial adverse health consequences. For example, considering only hepatitis C, prior studies from Karachi suggest that 21% of paid donors,<sup>14</sup> 2.4% of family donors<sup>10</sup> and 1% of volunteer donors<sup>15</sup> are infected with hepatitis C. The present study suggests that 31% of transfused units are from paid donors and only 23% of blood banks have equipment for hepatitis C screening. If we assume that these figures approximate the practices throughout this city, and that of the 69% of donors who are not paid half are volunteers and half are family donors, then of the estimated 153 400 units transfused each year in Karachi, 9072 (5.9%) could transmit hepatitis C virus. Even allowing for some inefficiency in transmission, a Karachi patient receiving a standard 2-unit transfusion faces an approximate 10% risk of contracting hepatitis C. These projections suggest that 7689 of the infected units (85%) come from paid blood donors. In addition to a high rate of transmission of viruses, the risk of bacterial contamination must also be high since 63% of the blood banks which produced components used an open system, 24% of blood banks had their refrigerator above the 6°C recommended by WHO, and the city suffers frequent power failures. Without intervention this highly dangerous scenario would be expected to worsen substantially as the HIV pandemic progressively spreads through Pakistan.

The Sindh AIDS control programme, informed by the results of this analysis, drafted legislation, The Sindh Transfusion of Safe Blood Bill, that on August 28, 1996 won legislative approval and became law. Key provisions of the bill included creation of the Provincial Blood Transfusion Authority, with responsibilities including government registration and licensing of all blood banks, and ensuring that blood banks are managed and run by qualified personnel and function in accord with WHO standards.<sup>16</sup> In addition, the legislation outlawed paid blood donation and explicitly required that blood banks have proper refrigeration and backup power supplies.<sup>16</sup> Advocates for the legislation explained that the data provided by this assessment of the blood bank was critical in winning support for the legislation. The most common query from legislators was, 'How do we know this is a problem?' The study of blood banks from Sindh, specifying and quantifying the problems, was repeatedly useful. There were at least two reasons why these efforts to translate this public health evaluation into policy were successful. First, provincial health authorities were already interested in this issue and were motivated to bring change before the study was ever conducted. The study provided the information that health authorities needed at the time they needed it. Secondly, this successful effort was focused at the provincial rather than the national level. Health delivery in Pakistan is a responsibility of the provincial government, and on the provincial level the group of professionals involved were a smaller group that already knew each other and worked well together. The logistics of performing one study in one city were also substantially easier than a national study would have been, and since the bulk of blood transfusions within Sindh occur in Karachi, a one city sample was sufficiently representative to convince legislators.

There are important limitations to this study. First, we cannot be confident that respondents answered

the questions honestly or that their behaviour under observation was typical of their behaviour when observers were not present. This problem was compounded by refusals to answer certain questions. However, we would expect both their responses and behaviours during the study to be consistently biased towards appropriate standard practices. Thus, the prevalence of sub-standard practices measured within this study should be considered minimum estimates. Secondly, it is possible that the selected blood banks and the timeframe of the study were not representative of the whole city during the course of a year. However, given the resource constraints of a developing country, the approach used in this study is a cost-effective means of acquiring information that should be substantially more representative than either general impressions of individual workers in the field or in-depth studies of individual blood banks.

There are also limitations to the effectiveness of legislation. The implementation in letter and spirit, and enforcement of the legislation, is untested. Indeed the mismatch noted in this study between what blood bank administrators said were their standard practices, and what equipment, supplies and practices were observed in the facilities, suggests that an objective assessment of compliance and quality assurance will be required.

There are clear economic barriers to safe transfusion practices in developing countries. Screening and storing blood safely requires trained personnel and expensive equipment and consumables. In the unregulated market for blood in Karachi, financial considerations, for example the recipient's willingness to pay for blood screening for infectious pathogens, were a central determinant of transfusion safety. And Karachi, where we found marked limitations in equipment and supplies, is the economic hub of the country. Sixty-six percent of Pakistan's population lives in rural areas<sup>9</sup> where there is no immediate access to blood transfusion services. Thus, to bring quality blood transfusion services throughout underdeveloped countries requires economic growth. This lack of optimal resources, however, should not limit public health advocates or developing country legislators from demanding accountability and efficient use of available transfusion resources. This study, for example, suggests that elimination of paid blood donors would be a particularly efficient way to improve the safety of the blood supply. Although this requires an aggressive public health effort, and a change in attitudes and orientation, it does not require substantial capital or technology. Moreover, this basic approach of collecting representative data of current practices may be a useful first step towards improving blood safety in other developing countries.

## **Acknowledgements**

This project was supported by the Department of Community Health Sciences, The Aga Khan University, Karachi, Pakistan.

## **Biographies**

Stephen Luby, MD, studied internal medicine at Strong Memorial Hospital, Rochester, NY, USA, and epidemiology at the United States Centers for Disease Control. He directed the epidemiology unit of the Department of Community Health Sciences, Aga Khan University, Karachi from 1993 to 1998. He is currently conducting research on diarrhoeal prevention in developing countries with the Centers for Disease Control.

Rafique Khanani, MBBS, is an assistant professor of pathology at Sindh Medical College. He is Secretary General of Infection Control Society, Pakistan.

Maliha Zia, MBBS, is a graduate of the Aga Khan University. She is currently working as a surgical house officer in Lahore.

Zuleikha Vellani, MBBS, is a graduate of the Aga Khan University, and has completed a one-year



internship at the same institution. She is pursuing an academic career in Family Medicine.

Mohsin Ali, MBBS, is a graduate of the Aga Khan University. He is currently an internal medicine resident at Syracuse University.

Abdul Haleem Qureshi, MBBS, is a graduate of the Aga Khan University. He is currently a surgical resident at the Aga Khan University Hospital.

Aamir Javed Khan, MBBS, was a Research Officer in epidemiology at the Aga Khan University Community Health Sciences Department (1994-97). He is currently a Research Associate at Johns Hopkins School of Public Health and Project Coordinator on a study for the Global Polio Eradication Program.

Dr. S. A. Mujeeb, MBBS, directs the Blood Transfusion Services at Jinnah Postgraduate Medical Center, Karachi.

Dr. Sharaf All Shah, MBBS, has been the Provincial Programme Manager, AIDS Prevention and Control Programme. Government of Sindh, Pakistan, since 1995. Before this he was the Senior Registrar, Dermatology and Sexually Transmitted Diseases, at Dow Medical College Karachi for 8 years, where he taught undergraduate and postgraduate medical students, and guided a research project in dermatology and sexually transmitted diseases.

Susan Fisher-Hoch studied medicine in London. After postgraduate training in virology and epidemiology, she worked with viral haemorrhagic fevers at the Centers for Disease Control and Prevention in Atlanta, USA. She is now responsible for the Biosafety Level 4 laboratory in Lyon, France.

Correspondence: Stephen Luby, MD, Centers for Disease Control and Prevention, Foodborne & Diarrheal Disease Branch, Mailstop A-38, 1600 Clifton Road, Atlanta, GA 30087, USA. Email [sx12@cdc.gov](mailto:sx12@cdc.gov)

## References

1. Demayer E, Adiels-Tegman M. The prevalence of anemia in the world. *World Health Statistics Quarterly* 1985; 38: 302-16.
2. World Health Organization. *The World Health Report 1995: Bridging the Gaps*. Geneva: World Health Organization, 1995.
3. Greenberg AE, Nguyen-Dinh P, Mann JM et al. The association between malaria, blood transfusions, and HIV seropositivity in a pediatric population in Kinshasa, Zaire. *Journal of the American Medical Association* 1988; 259(4): 545-9.
4. Aach RD, Stevens CE, Hollinger FB et al. Hepatitis C virus infection in post transfusion hepatitis. An analysis with first and second generation assays. *New England Journal of Medicine* 1991; 325(19): 1325-9.
5. McFarland W, Mvere D, Shandera W, Reingold A. Epidemiology and prevention of transfusion-associated human immunodeficiency virus transmission in sub-Saharan Africa. *Vox Sang* 1997; 72: 85-92.
6. Miiltä TK. Management of acute blood loss. *Vox Sang* 1994; 67(suppl 5): 59-61.
7. Britten FHA, Fereydoun AA, El-Nageh M (eds). *Blood transfusion: A basic text*. Alexandria: World Health Organization, 1994.
8. Lackritz EM, Ruebush TK, Zucker JR, Adungosi JE, Were JBO, Campbell CC. Blood transfusion practices and blood-banking services in a Kenyan hospital. *AIDS* 1993; 7: 995-9.
9. United Nations Development Program. *Human Development Report 1996*. New York: Oxford University Press, 1996.
10. Mujeeb SA, Mehnood K. Prevalence of HBV, HCV, and HIV infections among family blood donors. *Annals of Saudi Medicine* 1996; 16: 702-3.

11. Luby S, Qamruddin C, Shah A et al. The relationship between therapeutic injections and high prevalence of hepatitis C infection in Hafizabad, Pakistan. *Epidemiology and Infection* 1997; 119: 349-56.
12. Gibbs WN, Britten AFH (eds). *Guidelines for organization of Blood Transfusion Service*. Geneva: World Health Organization. 1992.
13. *Statistical Supplement. Economic Survey 1995-96*. Government of Pakistan. Finance Division. Economic Advisors Wing. Islamabad. 1997.
14. Ahrned A, Shamsi TS, Hafiz S, Hashmi KZ, Zafar MN, Syed S. Seroprevalence of Hepatitis B and C Virus among Professional Blood Donors-A Single Centre Study of 135 Donors in Karachi. *J Pak Med Assoc* 1995; 45: 309.
15. Kakepoto GN, Bhally HS, Khaliq G. Epidemiology of bloodborne viruses: A study of healthy blood donors in Southern Pakistan. *Southeast Asian Journal of Tropical Medicine and Public Health* 1996; 27: 703-6.
16. *The Sindh Government Gazette*. Karachi: Sindh Government. August 28. 1996, pp. 86-90.