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Occupational exposure to the risk of HIV infection among health care workers in Mwanza Region, United Republic of Tanzania

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During 1993, we collected data on knowledge of human immunodeficiency virus (HIV) transmission, availability of equipment, protective practices and the occurrence of prick and splash incidents in nine hospitals in the Mwanza Region in the north-west of the United Republic of Tanzania. Such incidents were common, with the average health worker being pricked five times and being splashed nine times per year. The annual occupational risk of HIV transmission was estimated at 0.27% for health workers. Among surgeons, the risk was 0.7% (i.e. more than twice as high) if no special protective measures were taken.

Health workers' knowledge and personal protective practices must therefore be improved and the supply of protective equipment supported. Reduction of occupational risk of HIV infection among health workers should be an integral part of acquired immunodeficiency syndrome (AIDS) control strategies.

Introduction

Although the occupational risk of health workers acquiring human immunodeficiency virus (HIV) infection is currently considered to be small (1), its importance is likely to increase, especially if other modes of HIV transmission become less important following interventions. Also, the number of HIV/acquired immunodeficiency syndrome (AIDS) patients will increase considerably in the coming decade, and provision of medical care to seropositive patients will become a major activity for many health workers.

The occupational risk of HIV infection among health workers depends on the following factors: the prevalence of such infection among patients; the incidence of events in which health workers are exposed to HIV-infected fluids; and the chance of transmission following occupational exposure to HIV. This article addresses the extent of HIV infection and the reasons for occupational exposure to the virus among health workers in the Mwanza Region in the north-west of the United Republic of Tanzania.

The prevalence of HIV infection in this region is high. On the basis of a population-based survey in 1990–91, it was estimated that 4.6% of adults in the age group 15–54 years were HIV positive. In urban Mwanza, 11.8% of adults were HIV positive (2), and infection rates among hospital patients are expected to be considerably higher.

Needle-stick injuries are the commonest form of HIV exposure in health-care settings (3). Studies in developed countries have reported injury rates ranging from 1.3% to 15.4% per surgical procedure (4). For developing countries, very few data are available on the occurrence of needle-stick injuries and other such events in which transmission of HIV may occur; however, because the training of health workers is generally less adequate than in developed countries, and supplies of hygienic and protective equipment are often lacking, the occurrence of incidents involving possible exposure to HIV is likely to be commoner.

The study was carried out between May and September 1993. Data were collected from nine hospitals in the Mwanza Region. Several factors that contribute to the risk of occupational exposure to HIV among health workers were examined: knowledge of the risks of HIV transmission in the workplace; occurrence of incidents involving possible exposure to HIV; availability of protective equipment; and use of hygienic and personal protective practices by health workers.

Methods

The nine main hospitals in the Mwanza Region were visited: the zonal referral hospital (Bugando Medical

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Centre in Mwanza town); three government district hospitals; four mission hospitals; and one additional government hospital. A total of 27 wards were covered, mostly medical and surgical, including four paediatric wards. In addition, all labour rooms, operating theatres, outpatient departments, casualty wards, and laboratories were surveyed.

Data were collected through observation and interviews. Health workers' knowledge about occupational risks of HIV transmission was assessed through an extensive self-administered questionnaire (72 questions in English). This was completed by those health workers present during the week of the interview, with the aim being to interview at least 10% of the estimated 3500 health workers in the regional hospitals. Where necessary, the research team assisted health workers in translating questions into Kiswahili, the national language. In addition, a structured questionnaire was used to interview health workers about the incidence of being pricked or splashed during the previous 24 hours, week, and month. This was repeated one month later to assess the incidence of such incidents during the month between the two interviews.

A prick accident was defined as a prick with a needle or other sharp object (scalpel, glassware, etc.) that occurred after using that object for patient care. Usually the sharp object would have been in contact with the patient's body fluids (blood, pus, amniotic fluids, etc.). A splash accident was defined as a splash of any body fluid from a patient onto the skin or mucous membrane of a health worker during care or the handling of a specimen.

The incidence of prick accidents among surgeons, assistant surgeons and scrub nurses during major operations (i.e. all laparotomies, vesicovaginal fistulae repairs, major bone surgeries, thyroidectomies, prostatectomies, etc.) was assessed. Surgical staff were given an adequate supply of new gloves for use during the survey period. After surgery, surgical team members were asked to report prick accidents, and used gloves were inspected for puncture holes by filling them with water. The occurrence of prick accidents was calculated per person-procedure, defined as one person participating in one procedure (operation). A two-person procedure could thus be either one surgeon and one assistant surgeon participating in one operation or one surgeon participating in two operations.

In each of the wards in all the hospitals visited, observations were made over a week to assess the availability of general hygienic facilities and equipment, the practices for the disposal of contaminated materials, and the availability of specific protective clothing and equipment. In addition, at least 13 risky procedures being undertaken by health care workers

were observed to assess personal protective measures.

All data were entered into a computer using dBase IV, and analysed with SPSS/PC 4.0 and Stata 3.0 software.

Results

Knowledge of occupational risk factors

The questionnaire containing 72 questions on possible risk factors for HIV transmission in the work setting was sent to 434 health workers; of these, 403 were completed (92.8%). Table 1 shows the distribution of health workers according to correct response rates. Staff were grouped into the following categories: medical staff (medical officers, assistant medical officers, medical assistants, and rural medical aides), nurse-midwives, nursing officers, nurse assistants, nurse attendants, laboratory workers and other staff.

Overall, 71% of the questions were answered correctly. Medical staff had the highest knowledge scores, followed by nurse-midwives and nursing officers. Lower grade staff in the hospital hierarchy had the poorest scores, perhaps in part because they were less proficient in English. If 75% is taken as an arbitrary cut-off point for adequate knowledge, 65% of the health workers had inadequate knowledge of the occupational risks of HIV transmission. Half of the medical staff, but over 90% of nurse attendants, scored less than 75% of the answers correctly (Table 1).

The knowledge questions could be divided into the following broad categories: transmission, general prevention, misconceptions about transmission risks, and perception of occupational risks for health workers. The proportion with correct answers was

Table 1: Knowledge of health workers about occupational risk of HIV transmission and protective practices in nine hospitals in Mwanza Region, United Republic of Tanzania, 1993

Occupational group	No. interviewed	% of correct answers	% with < 75% of answers correct
Medical	70	75	51
Nurse/midwife	75	73	56
Nursing officer	75	73	58
Nurse assistant	108	66	76
Nurse attendant	22	66	91
Laboratory	50	70	70
Other	3	NA ^a	NA ^a
Total	393	71	65

^a NA = not available.

lowest for transmission (52%), while better scores were achieved for questions on risk perception (82%), misconceptions (73%), and preventive measures (72%).

Questions were also classified according to occupational group; for example, several referred primarily to laboratory activities, and others to medical or nursing procedures. The results (not shown) did not differ from the analysis presented above. None of the occupational groups had significantly better knowledge about risks concerning their own professional activities.

Awareness of the risk of transmission during prick and cut accidents was high. However, contact with vaginal fluid was perceived to be just as risky as contact with serum. A small proportion of health workers perceived no risk from the following body fluids of HIV-positive patients: vaginal secretions (5%), serum (5%), and wound discharge (18%). On the other hand, more than 40% thought that saliva, sputum and vomitus without blood could transmit HIV.

Knowledge of the window period that occurs after HIV infection but before an HIV serological test can detect antibodies was limited (17.8%). The extent to which contaminated surfaces pose a risk of infection appeared to be underestimated by many health workers. The appropriate procedures for providing maximum protection for health workers were not known to all respondents.

General hygienic conditions

Table 2 shows the availability of facilities and equipment needed to ensure general hygienic practices in

various departments of the hospitals. Water taps were observed in all departments, except the labour room in one peripheral hospital and the female ward in another. However, the presence of a tap did not guarantee running water: only about one in three of the taps functioned. In all except two cases where no tap water was available, a container with clean water was available for washing. Soap for hand-washing was available in most cases, but not in six of the 27 wards (all of them in government hospitals), one labour room, and two laboratories.

All but four wards had at least one puncture-proof container for disposal of sharp objects, though only one-fifth of such containers were covered. Eight outpatient departments had such containers. In about half of the departments there were containers for the disposal of sharp objects in all rooms, and in addition to static containers some outpatient departments and wards also had portable ones. In the operating theatres of seven of the hospitals, sharp instruments and needles were placed in a container located close to the operating table.

Chlorocresol solution (1:20 dilution) and chlorine (bleach) are the recommended disinfectants for reducing HIV transmission in health care settings. Fresh disinfectant solution was common in the labour rooms (eight of the nine), but less so in the wards, outpatient departments, and laboratories. A range of antiseptics was observed: cetrimide/chlorhexidine was the commonest (37%), followed by chloroxyleneol (20%), chlorhexidine (17%), and cetrimide (17%). In only one labour room and one outpatient department was chlorocresol available.

Plastic bags, the preferred means of disposing of soiled linen, were observed rarely (Table 2). For

Table 2: Availability of facilities, equipment and gloves needed to ensure general hygienic practices

	% present in:				
	Wards (n = 27)	OPD ^a (n = 9)	Labour rooms (n = 9)	Laboratories (n = 11)	Theatres (n = 11)
Water taps	96	100	89	100	91
Running water	33	44	33	22	36
Soap for hand-washing	78	78	89	82	100
Presence of containers for sharp objects in each room	37	56	89	73	73
Portable container for sharp objects	41	22	—	—	—
Fresh disinfectant	44	67	89	27	73
Plastic bags for linen	11	11	22	0	0
Waste disposal in pit	48	67	33	50	56
Waste disposal by incineration	30	—	11	—	—
<i>Gloves:</i>					
>10 new pairs	11	11	22	45	45
>10 reused pairs	33	33	33	9	82
None at all	30	60	44	27	9

^a OPD = outpatient departments.

about half of the departments, waste was disposed of in a pit. In none was the waste buried. Incineration was the mode of disposal in six general wards, mostly in one peripheral (mission) hospital. At the referral hospital, waste was removed by municipal vehicles. In the laboratories, a range of methods were used, including throwing waste into shallow pits (four laboratories), putting it into a container and dropping it into a latrine (one), and disinfecting it and then pouring it into a sink (three).

Blood spots were observed on outpatient department benches after completion of the procedures in two of the nine hospitals. In addition, in four hospitals health workers were observed to continue wearing soiled gloves after the procedures had been completed.

All nurses wore uniforms. Doctors were consistently in uniform in only two hospitals and occasionally wore uniforms in another four hospitals. Laboratory staff and labour ward staff did not consistently wear uniforms.

The plastic covers of operating table mattresses were without puncture holes in all hospital theatres, except in one peripheral hospital. The plastic mattress covers were cleaned with an antiseptic after each operation; however, in the referral hospital and in one peripheral hospital this was not done consistently. Plastic mattress covers were available in all labour rooms and theatres, but there were holes in some of the covers in two labour rooms.

Availability of protective clothing and equipment

The availability of gloves in hospitals by type of department is shown in Table 2. Shortage of gloves was widespread. For example, more than half of the outpatient departments had no gloves at all and only one of the nine wards (11%) had more than ten pairs of new gloves in stock. Operating theatres had the best supplies of gloves, while labour rooms clearly had to conduct many procedures without gloves. Bugando Medical Centre and the other mission hospitals predominantly used new gloves in the theatre, but in the government hospitals re-used gloves were the main source of protection.

Forceps to remove syringes were available in 64% of the wards and in two-thirds of outpatient departments. Aprons were available in labour rooms and all but one theatre, but not in the wards, and in only three outpatient departments. Surgical gowns were in short supply in three government hospitals, while at least ten surgical gowns were observed in six of the 11 theatres. Long-sleeved gloves, used for manual removal of the placenta, were available in three labour wards and four theatres.

Rubber boots were reported in eight labour wards and nine theatres, while masks were available in 10 of the 11 theatres, but rarely in labour rooms (in only one hospital). Protective eyewear was only available in one hospital. Mouthpieces for resuscitation were available in three labour rooms and six theatres. Two hospitals also had mouthpieces in the outpatient department.

Protective practices

Spectacles were only used in the theatre and labour ward of one hospital. All surgical staff used masks during major operations, but none of the labour-ward staff ever used masks.

Aprons were consistently used by staff during deliveries and bloody surgery in all hospitals with one exception, where aprons were only used occasionally. In the labour ward of one hospital, rubber boots were used all the time, while three hospitals used them infrequently. Long rubber boots were always worn during major operations in two-thirds of the theatres.

As far as labour room procedures were concerned, suturing of a perineal tear or episiotomy was consistently carried out wearing gloves in eight of the nine hospitals. Spectacles and boots were rarely used. In five labour rooms suturing was performed with a needle-holder and a dissecting forceps for the skin. During the repair, vaginal bleeding was always controlled using a large pad of cotton wool or gauze before suturing in one-third of the labour rooms. No mouth covers were worn during the expulsive phase of delivery.

Long rubber gloves were always worn for manual removal of the placenta in only two hospitals. In two other hospitals such gloves were sometimes used; they were not used in the remaining five hospitals.

The umbilical cord of the newborn was tied while gloves were worn in all but one labour room. Similarly, apart from one hospital, all newborn babies were handled with gloves for postnatal care until they had been washed.

The use of gloves in hospitals during various other practices varied. Only a few health workers wore gloves during venepuncture (16%) and wound dressing (30%). Glove use among laboratory staff (6%) was even lower than among other staff. Only labour room staff appeared to make consistent use of gloves during deliveries and vaginal examinations (100%).

Proper recapping of used needles should be carried out with the cap on the table. Recapping errors, which increase the risk of prick accidents, were observed in four of the 27 wards and one of the nine

Table 3: Recall of prick and splash accidents among health workers during the second ($n = 399$) rounds of interviews

Occupational group/recall period	% with prick accident	% with splash accident
	Round 2	Round 2
<i>Medical staff</i>		
Previous 24 h	2	3.9
Previous week	9.8	17.6
Previous month	2	29.4
<i>Nurses</i>		
Previous 24 h	2	5.1
Previous week	10	17.2
Previous month	8.9	24.1
<i>Laboratory technicians</i>		
Previous 24 h	0	8.9
Previous week	11.1	15.6
Previous month	13.3	26.7

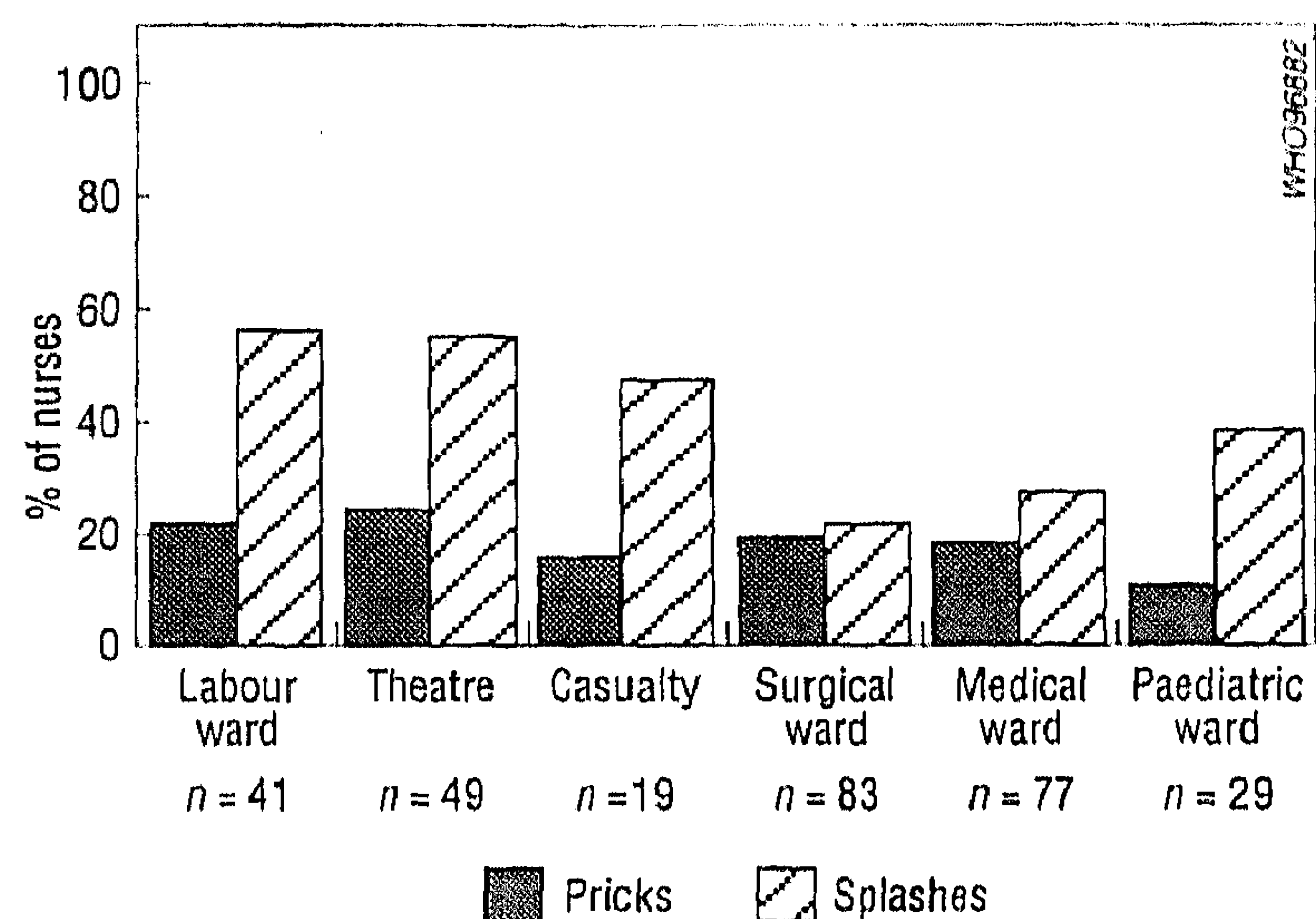
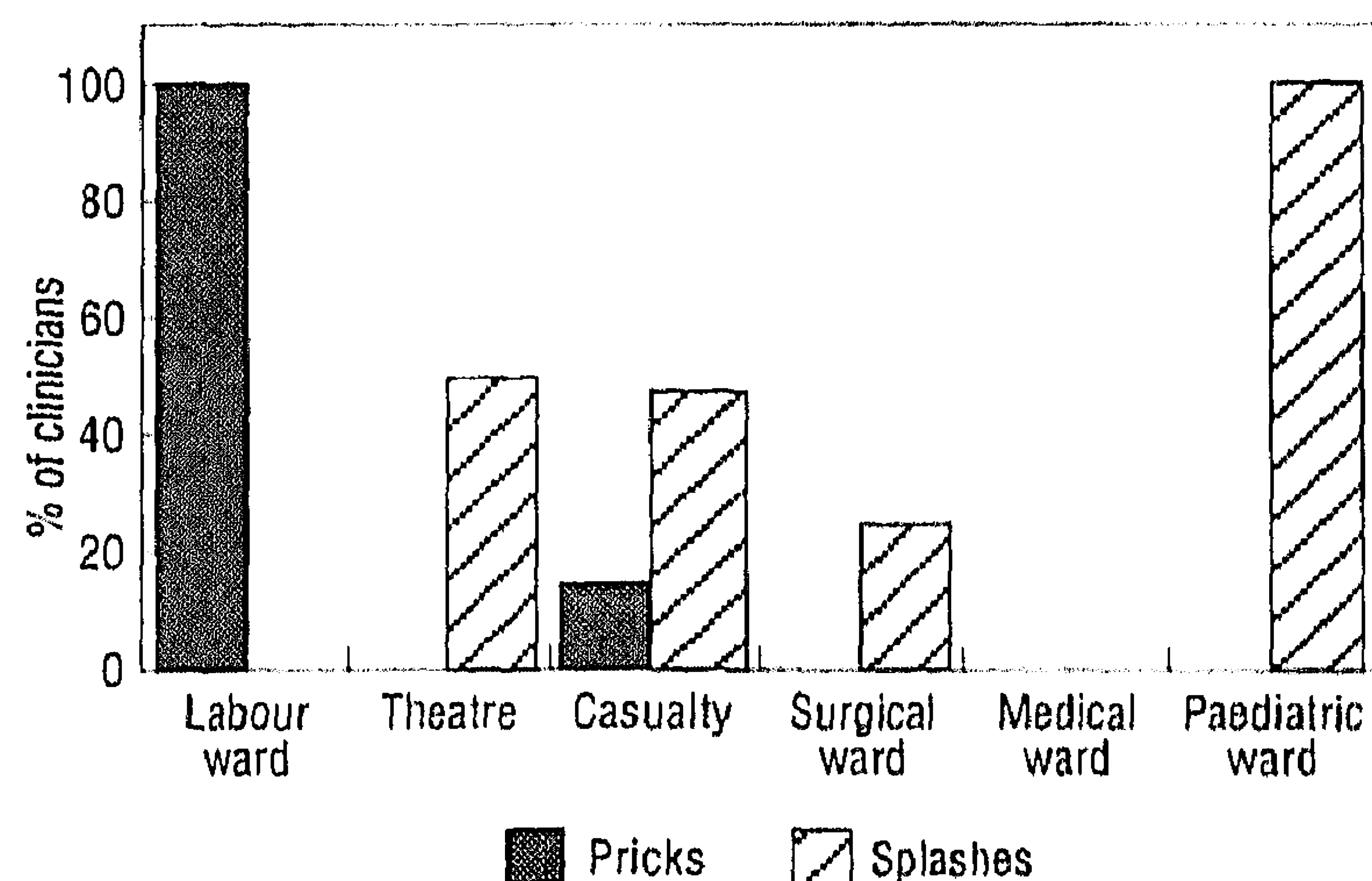
outpatient departments; needles were recapped after use, while holding the cap in one hand.

Prick and splash accidents

A total of 434 health workers, mostly nurses, but also doctors and medical assistants, were interviewed about prick and splash accidents. Table 3 shows that such accidents were common. For example, 15% of health workers had pricked themselves during the previous month and 31% had been splashed. During the week prior to the survey 7% had pricked themselves and 16% had splashed themselves.

The second interview took place four weeks after the first. The recall of health workers is assumed to be better after having been alerted during the first round of interviews. Indeed, the proportion of health workers who reported a prick accident was higher than during the first round of interviews; for example, 12% of health workers reported a prick accident during the previous week and 20% a splash accident.

Combining the data for both rounds indicated that 9.2% of 623 nurses had pricked themselves during the week preceding the interview, and 1.3% of 118 doctors and medical assistants reported such accidents; 22% of the nurses working in labour wards and 25% of those working in theatres had been pricked in the previous month (Fig. 1). Labour wards and casualty departments appeared to have the greatest risk for the 51 clinicians interviewed during the second round (Fig. 2). Among the 50 laboratory technicians, 25% had pricked themselves in the previous month. During the same recall period of one month, more than half of the nurses working in labour wards and theatres had been splashed as had half of the physicians working in theatre and casu-

Fig. 1. Recall of prick and splash accidents, by ward, among nurses ($n = 298$).Fig. 2. Recall of prick and splash accidents, by ward, among clinicians ($n = 51$).

ality; the proportion for laboratory technicians was 38%.

Among the prick accidents 77% were needlesticks and the remainder were pricks from other sharp objects. Visible bleeding was experienced by 75% of those who had pricked themselves. Gloves were worn during 53% of the prick accidents. Most of the splashes were on the intact skin (88%), followed by mucous membranes and non-intact skin. The commonest type of splashes were blood and amniotic fluid. Appropriate protective devices had been worn in 62% of the splash accidents (i.e. either aprons or rubber boots or eyewear, depending on the site of the splash).

From the above and the data in Table 3, the incidence of prick accidents per health worker per year was obtained as follows:

Average weekly incidence of pricks experienced by health workers = $(7.1 + 12.0)/2 = 9.5\%$

Therefore 0.095 (No. of health workers pricking themselves in one week) $\times 52 = 5$ prick incidents per health worker per year. The splash incidence per health worker per year was 9.

Average splash incidence per week = $(16.1 + 20.3)/2 = 18.2\%$.

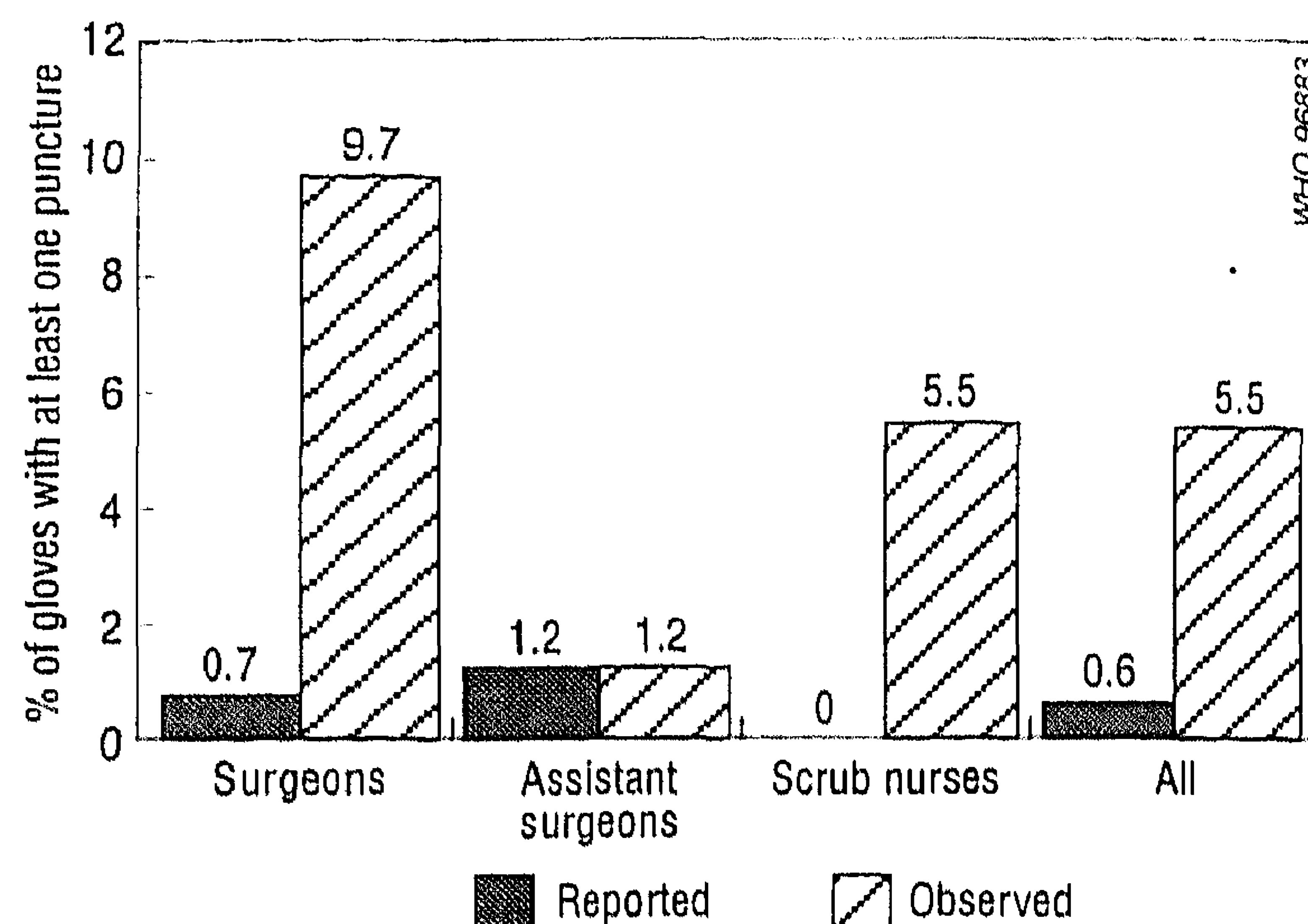
Therefore, 0.182 (health workers experiencing a splash per week) $\times 52 = 9$. Since 8% of such splashes were on mucous membrane, this incidence would be 0.73, i.e. approximately equal to 1.

Reported prick accidents and observed glove perforations during surgery

The occurrence of prick accidents among surgical staff included the surgeons, surgical assistants, and scrub nurses involved in 154 major operations in the nine hospitals. In total, 488 person-procedures were observed. The majority of surgical staff wore double pair of gloves per operation (75%), while 24% used a single pair. Two-thirds of the scrub nurses used a double pair.

The reported incidence of prick accidents was low among the surgeons, surgical assistants and scrub nurses participating in the study. Only one surgeon and two first assistants reported a prick accident during the study week. Therefore such an accident was reported in three of the 488 person-procedures (0.6%, Fig. 3). Examination of the gloves worn, however, showed a higher occurrence of such accidents. Of the total of 1667 gloves tested for leakage after the operations 22 were perforated; the total number of holes was 27. Approximately 2.5% of the gloves used by the surgeons were perforated, but only 0.3% of those worn by assistant surgeons and 1.3% of those worn by scrub nurses. Surgeons had a punctured glove in almost 10% of the procedures,

Fig. 3. Reported and observed gloves perforated during 154 major operations.



compared with only 1% for surgical assistants and 6% for scrub nurses. In most cases a single glove had been punctured. In four cases (two surgeons and two scrub nurses) punctures were observed in two gloves (on the same hand). Altogether, for the theatre staff, the rate of exposure to blood through glove punctures was 5.5% (27 glove perforations per 488 person-procedures, Fig. 3).

Discussion

Our results show that most health workers generally have some appreciation about the most risky procedures in their work, although there is still considerable scope for improvement. The general hygiene measures taken in the study hospitals to reduce the risk of HIV infection were insufficient. Many other inadequacies stem from lack of supplies. However, even when protective equipment was available, it was often used inconsistently or improperly. Prick and splash accidents were common, which implies that there was an occupational risk of HIV infection among health workers. For example, the recall data indicated the occurrence of about at least five prick accidents and nine splashes, including one splash on mucous membranes, per health worker per year. Surgeons had a perforated glove in one of ten operations.

What are the annual and lifetime risks of HIV seroconversion associated with such occupational exposure in a population where the prevalence of HIV infection is high?

The annual incidence of infection is the product of the HIV prevalence among the hospital population, the number of exposure incidents per year, and

the risk of seroconversion per incident (5). Results from 21 studies in developed countries and Brazil showed a 0.25% risk of seroconversion after percutaneous exposure (4). In six studies the average risk was 0.09% after mucous membrane exposure. Non-intact skin contamination carries a very low risk of infection. Using these risks of seroconversion after exposure, a presumed HIV prevalence of 20% among hospital patients in Mwanza region, and an exposure of five prick accidents and one mucous membrane splash accident per year per health worker, we calculated the annual incidence of HIV infection among our study population due to occupational exposure to be 0.27%. Thus, the risk for a health worker working for 5 years is 1.3%, mainly from percutaneous exposure (93% of the risk); mucous membrane splashes contribute much less to the risk of seroconversion.

Surgeons run even higher risks of HIV seroconversion since they prick or cut themselves more often. For example, with four operations per week, and assuming that the 9.7% glove perforations among surgeons were true percutaneous prick accidents experienced by them per operation, the annual incidence given by:

(risk of seroconversion after prick incident) \times 38 (work weeks per year, actually operating) \times 0.2 (seroprevalence among patients) = $4 \times 0.097 \times 0.0025 = 0.7\%$; and the 5-year risk of seroconversion was 3.5%.

Different incidences were found for recalled prick accidents (0.7%) versus observed glove punctures (9.7%), and this may indicate that surgeons underestimate their risk. However, it may also mean that the prick accidents did not pierce the skin. The annual incidence of 0.7% and the 5-year risk of 3.5% should be considered the maximum possible values, while the true risk is smaller. Based on recalled prick accidents, the annual incidence would be 0.05%.

How high should reduction of occupational exposure to HIV infection among health workers be on the list of interventions against the HIV pandemic?

The above estimates of the incidence of HIV infection among health workers caused by occupational exposure are not insignificant compared to risks associated with sexual behaviour and other modes of transmission. There is no estimate of the incidence of HIV infection among adults in Mwanza Region. The incidence of HIV infection among a cohort of predominantly male factory workers in Mwanza was 1.2% during 1991–93 (6), which should be considered a minimum estimate for the Mwanza adult population. Even if the incidence of HIV infection in the urban Mwanza population is as high as 2–2.5%, the additional occupational risk of 0.27% among our study population is sufficient to justify

efforts to reduce HIV infection rates among health workers at work.

Cross-sectional studies in developing countries have not shown that there is an additional HIV risk for health workers, since in both Zaire (7) and Senegal (8) seroprevalences among health workers were the same as those among the general population. However, it cannot be excluded that behaviour relating to other risk factors also differed, thus masking an increased risk caused by occupational exposure.

Furthermore, it can be argued that the importance of this occupational mode of transmission is likely to increase, especially if other modes become less important following interventions. The number of HIV/AIDS patients will increase considerably in the coming decade and provision of medical care to seropositive patients will become a major activity for many health workers. Incorrect knowledge, insufficient equipment, and inadequate safety practices not only increase health workers' exposure to the risk of HIV infection, but are likely also to increase patients' risk of exposure (e.g. through sharing needles).

Against this background, a concerted effort is needed to improve health workers' knowledge of occupational exposure to the risk of HIV transmission, and personal protective measures and practices. Prevention of pricking accidents should be a priority, since the majority of infections occur through needles and other sharps. Focusing on high-risk groups, such as surgeons, may be more cost-effective where resources are scarce. Double-gloving by surgeons and use of a single pair of gloves for laboratory staff and other staff handling needles are needed (9, 10). Since the ventral aspect of the non-dominant index finger is affected in more than 50% of pricking accidents (11), this finger needs extra protection. In addition, forceps to remove syringes and appropriate needle containers for disposal are required. Long-sleeved rubber gloves for staff involved in the manual removal of placentae are essential. Equally important, attention must be given to strict working discipline and care in handling sharp instruments.

Furthermore, there is a need to follow strictly a proper procedure for bloody, risky procedures (such as episiotomies). Risk is reduced by providing adequate equipment and proper training.

Prevention of splash accidents reduces to only a small extent occupational risk of HIV transmission among health workers. Nevertheless, since provision of protective equipment for this purpose is relatively easy, it should be considered. Aprons, protective eyewear, masks, etc. do not need rapid replacement and can be used for prolonged periods.

Reducing the occupational exposure to the risk of HIV infection among health workers through training and the supply of equipment should bring a number of other benefits, which should be taken into account in setting priorities for HIV/AIDS control measures. These include: the reduction of the risk of viral hepatitis B among health workers; a reduction (albeit small) in the risk of health-worker-to-patient transmission; and the likely improvement in injection and sterilization practices, leading to a reduction of patient-to-patient and health-worker-to-patient transmission.

In view of the prevalence of HIV infection and the frequency of occurrence of occupational exposure to the virus, control measures to reduce the risk to health workers should not be ignored. Such measures should be an integral part of national AIDS control strategies.

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Résumé

Exposition professionnelle à l'infection à VIH chez les agents de santé de la région de Mwanza, en République-Unie de Tanzanie

En 1993, des données ont été recueillies sur la connaissance des risques de transmission du virus de l'immunodéficience humaine (VIH), la disponibilité des équipements de protection, les pratiques de sécurité et les cas de piqûres ou de projections accidentelles dans neuf hôpitaux de la région de Mwanza, dans le nord-ouest de la République-Unie de Tanzanie.

Ces incidents sont relativement courants, car on a recensé en moyenne cinq cas de piqûres et neuf cas de projections par an pour chaque agent

de santé. Le risque annuel de transmission du VIH lié à la profession a été estimé à 0,27 % pour ces personnels. Chez les chirurgiens, le risque est de 0,7 % (c'est-à-dire plus du double) en l'absence de mesures spéciales de protection.

Il convient donc de développer les connaissances des agents de santé en la matière ainsi que les mesures de protection personnelle. La mise en pratique de ces mesures doit également être favorisée. La réduction du risque professionnel d'infection par le VIH chez les agents de santé doit faire partie intégrante des stratégies de lutte contre le SIDA.

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