

Université de Montréal

**Prevention of HIV Infection in the Health Care Setting :
Evaluation of an Education Programme
for Malian Health Workers**

par
Suzanne Dumais

Département de médecine sociale et préventive
Faculté de Médecine

Mémoire présenté à la Faculté des études supérieures
en vue de l'obtention du grade de
Maître ès sciences (M.Sc.)
en santé communautaire
option recherche

Décembre 1998

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Ce mémoire intitulé

**Prevention of HIV Infection in the Health Care Setting :
Evaluation of an Education Programme
for Malian Health Workers**

présenté par
Suzanne Dumais

a été évalué par un jury composé des personnes suivantes

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Summary

In developing countries, the risk of HIV transmission in the health care setting has not been fully examined despite health care workers' frequent exposure to blood and body fluids. As the number of known and unknown HIV and AIDS patients increases, many frontline health care workers have yet to benefit from additional training on issues related to HIV and infection control measures such as universal precautions.

This study developed, implemented, and evaluated an educational program on universal precautions with the aim of preventing the transmission HIV infection in the Malian health care setting. Since few educational materials were available for Malian health care workers, a video and an accompanying written guide were created locally in order to reflect their experiences. This training program also introduced sustainable technology by using locally adapted strategies for HIV prevention in the workplace in order to reduce health care worker exposure to HIV and other bloodborne pathogens.

A four-hour training program was subsequently implemented in four urban settings including two community clinics and two hospitals. A total of 82 health care workers attended the training session. Fifty-eight participants completed both baseline and post-intervention questionnaires which measured four concepts: health care worker's knowledge of the modes of HIV transmission, their knowledge of universal application of precautions, their knowledge of prevention of needlestick exposure and their accuracy in assessing occupational risk of HIV.

Comparison of participant's baseline and post-intervention questionnaire scores show an overall gain in all three knowledge areas. Knowledge levels of needlestick prevention show the greatest level of improvement. This is of particular interest since accidental needlestick exposure is considered the most effective route for occupational transmission of bloodborne pathogens. In addition, among all concepts studied, findings regarding participants' ability to accurately assess their risk for HIV exposure yielded the least improvement. These results further accent the need to offer more regular educational inservices for all staff members, especially direct care providers.

Participant's socio-demographic characteristics are not significantly associated with levels of observed change. Despite this fact, certain tendencies do emerge. Findings suggest that midwives, nurses, and lab technicians showed higher improvement levels than physicians who had higher baseline knowledge. Similarly, older health care workers seemed to have gained more knowledge from the inservice than their younger colleagues.

This study further highlights the need to implement and evaluate health care training programs in developing countries. First, it is important to develop adaptable site-specific technology for implementing universal precautions policies in the health care setting. Second, other strategies need to be explored, such as health worker training, in order to ensure the sustainability of these programmes. Furthermore, in light of the fact that only 30 percent of all health care workers who attended the inservice had attended at least one previous training session in HIV, continuing education should be accessible to all levels of health care workers. Easy to administer measurement tools with greater reliability also need

to be constructed with more accurate measures of the effects of these education programs. Finally, qualitative data such as indepth interviews and observation would be useful in examining health care workers' behaviours in order to generate further understanding of their occupational risk and develop more relevant training programs in HIV and AIDS.

Résumé

Le risque de transmission du VIH dans les services de santé des pays en voie de développement a été peu étudié malgré l'exposition fréquente des travailleurs de la santé aux produits sanguins et l'augmentation dans le nombre de patients séropositifs ou sidéens (diagnostiqué ou non). De plus, plusieurs travailleurs de première ligne n'ont toujours pas bénéficié de formations complémentaires sur l'infection par le VIH ainsi que sur les mesures de contrôle de l'infection telles que les précautions universelles.

Cette étude a développé, mis en place et évalué un programme d'éducation sur les précautions universelles qui avait pour but de prévenir la transmission du VIH dans les services de santé au Mali. Étant donné le peu de matériel éducatif disponible pour le personnel de santé malien, un film vidéo et un guide d'accompagnement ont été créés localement afin de refléter leurs expériences. Ce programme de formation a également introduit des technologies durables par l'utilisation des stratégies adaptées localement afin de réduire l'exposition du personnel des services de santé au risque de transmission de ce virus et d'autres agents pathogènes transmis par le sang.

Le programme de formation, d'une durée de 4 heures, a été implanté dans 4 sites urbains ; deux cliniques communautaires et deux hôpitaux. Au total, 82 travailleurs de la santé ont assisté à la formation et 58 ont complété un questionnaire avant et après l'intervention. Ce questionnaire mesurait 4 concepts; les connaissances sur les modes de transmission du VIH, les connaissances sur l'application des précautions universelles, les connaissances

sur la prévention des piqûres accidentelles et la capacité d'évaluer son risque professionnel.

Les résultats de cette étude montrent que les participants ont bénéficié du programme de formation. La comparaison entre les données des 2 questionnaires (avant et après la formation) indiquent une amélioration des connaissances. L'amélioration la plus forte est observée pour les connaissances sur la prévention des piqûres accidentelles. Ceci est particulièrement intéressant étant donné que les piqûres accidentelles représentent la voie la plus fréquente de transmission des agents pathogènes transmis par le sang chez les travailleurs de première ligne.

Les caractéristiques socio-démographiques des participants ne sont pas reliées de façon significative aux changements observés. Malgré tout, certaines tendances émergent. Les sages femmes, les infirmières et les techniciens de laboratoire ont augmenté leurs connaissances de manière plus importante que les médecins qui avaient au départ un niveau de connaissance plus élevé et les participants plus âgés ont acquis plus de connaissance suite à la formation.

Cette étude montre que l'implantation et l'évaluation de programmes de formation sur les précautions universelles dans les pays en développement nécessitent une attention particulière. D'abord, il est important de développer des technologies pour l'implantation des précautions universelles qui soient adaptées au milieu. Il faut également explorer des stratégies telles que la formation des travailleurs de la santé afin d'assurer la pérennité de ces implantations. De plus, les programmes de formation continue doivent viser les travailleurs de la santé à tous les niveaux (dans cette étude, seulement 30% des participants avaient déjà

suivit au moins une formation sur le VIH). Il faut aussi élaborer des outils plus simples et plus fiables afin d'accroître la précision de la mesure des effets de ces programmes. Finalement des données qualitatives aideront à mieux comprendre le comportement des travailleurs de la santé et leur risque professionnel, ce qui permettra de développer des programmes plus pertinents dans le domaine du VIH et Sida.

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**« If the cure for AIDS was one clean glass of water,
most people in the world today would not have access to treatment. »**
- Dr. Josef Decosas, a consultant on international public health

1. Research Problem

1.1 Problem

Over 30 million people world-wide are infected with the human immunodeficiency virus (HIV) (Mann & Tarantola, 1996). Today, sub-Saharan Africa accounts for 54 percent of the global population who are infected or living with HIV. Experts predict that the total number of people infected with HIV will exceed 40 million by the year 2000 with 85 to 90 percent of infections occurring in developing countries (Gates, 1992). Twenty-five percent of those infected will live in sub-Saharan Africa. By the turn of the century, public health scientists project that the peak of the epidemic will shift away from the sub-Saharan region and move towards Southeast Asia and Latin America. Yet, many uncertainties can still influence the course of this pandemic and any future projections will likely underestimate the true magnitude of the situation since many AIDS cases remain unreported (Mann & Tarantola, 1996).

Despite the efforts of primary prevention programs to decrease transmission of HIV infection in the general population, the epidemic continues to spread and the number of hospitalised AIDS cases continues to steadily climb (Mann & Tarantola, 1996). Additional measures must therefore be taken to equip health care workers to meet the challenge of caring for increasing numbers of HIV infected persons.

Two conditions have been noted as important proliferating factors that influence the course of HIV infection: a high background of HIV prevalence and significant levels of poverty (Preble, Elias, & Winkoff, 1994). Health care centres

in many developing countries often confront these two conditions and are thus ideal sites for nosocomial and occupational transmission of HIV infection (Walley, 1994). HIV prevalence among hospitalised patients is on the rise. In addition, financial and technical health care resources are scarce. This climate can create potentially harmful side effects for both patients and workers.

Health care workers, particularly midwives and those who are most frequently in contact with blood, are often exposed to untested blood products throughout the day (Preble et al., 1994). In addition many developing countries have unreliable blood supply testing and patients are still at risk of being transfused with products which have not been screened for HIV and other bloodborne pathogens (Gibbs & Corcoran, 1994; Gilmore, 1996). Women are particularly vulnerable since they more frequently require blood transfusions because of increased anaemia and post-partum haemorrhage (De Bruyn, 1992; Farmer, Lindenbaum, & Good, 1993). Although sexual contact remains the main route for transmission of HIV in women, parenteral transmission cannot be ignored especially in countries with high fertility rates, limited access to perinatal care, and unsafe blood supplies. As more and more women become infected with HIV, there is a growing need for a concerted effort to limit nosocomial exposure to HIV.

With a continual increase in hospitalised patients living with AIDS, studies in developing countries report a decreased retention rate of qualified health care professionals (Buvé et al., 1994; Chime & Ndulo, 1993; Wiley, Heath, Acklin, Earl, & Barnard, 1990). Health care workers who have experienced occupational

exposure are more likely to change their speciality or even leave their profession entirely (Turner, 1993). Not only does the health care worker's behaviour increase their exposure to bloodborne pathogens, but potentially, may also increase their patients' exposure (Cronin, Quansah, & Larson, 1993).

To date, universal precautions are the only effective means of reducing the risk of exposure to HIV and other bloodborne pathogens in the health care setting (Campbell, 1991; Greenbaum, 1993; Hersey & Martin, 1994; Konecny, 1994; Santé, 1989; Sherting, 1993). Despite the effectiveness of these precautions in protecting health care workers and their patients against potential exposure, they regularly fail to apply them (Baraff & Talan, 1989; Courington, Patterson, & Howard, 1991; Cronin et al., 1993; Danchaivijitr et al., 1995; Gershon et al., 1995; Hammond, Eckes, Gomez, & Cunningham, 1990; Henry, Campbell, Collier, & Williams, 1994; Henry, Campbell, & Maki, 1992; Larson & Kretzer, 1995; Odujinrin & Adegoke, 1995; Picheansathian, 1995; Pugliese & Lampinen, 1989; Valenti, 1994). In both developed and developing countries, many studies report that strict implementation of universal precaution techniques is far from systematic and that health care worker exposure to bloodborne pathogens is frequent.

The cost of implementing universal precautions is cited as a major barrier for implementing universal precautions policies. However, this factor alone does not appear to influence their systematic utilisation (Koenig, Frias, & Minguez, 1992). Consequently, most institutions focus on changing health care workers' behaviours by promoting staff inservices on universal precautions. Studies have

addressed the effectiveness of education programs in changing health workers' knowledge, attitudes, beliefs and practices in North American health care settings (Brandon et al., 1992; Cervero, 1985; Gallop, Taerk, Lancee, Coates, & Fanning, 1992; Sokas, Simmens, & Scott, 1993; Talan & Baraff, 1990; Wertz, Sorenson, Liebling, Kessler, & Heeren, 1987), but few have documented the particular challenges and benefits associated with implementing similar types of programs in developing countries (Webster & Nnabugwu, 1993). Likewise, little materials have been developed to meet the continuing educational needs of health workers working with few material and technological supports. This component is essential if health care workers are to disseminate prevention information among the general population and to their fellow colleagues.

1.2 Research Question and Objectives

This study aims to evaluate an education program specifically designed for Malian health care workers practising in four urban health care facilities. The effectiveness is evaluated before and after the education program by examining health care workers' accuracy in assessing occupational risk of HIV as well as their knowledge levels in the following three areas: modes of HIV transmission, universal application of precautions, and prevention of needlestick exposure. In addition, associations among these concepts are explored. Potential socio-demographic determinants in relationship to these concepts are investigated. Finally, an assessment of Malian health workers' perceived barriers to the consistent practice of universal precautions are identified.

1.3 Study Context

This study was done at the request of Pr. Éric Pichard, a physician in the department of medicine at Hôpital Point G, École de médecine in Bamako, Mali. It was seen as a complement to his own research, which had raised concerns of high professional exposure to bloodborne pathogens among hospital staff workers in Mali. His findings, presented in Dakar at the VIth International Conference on AIDS in Africa, indicated that the level of fear among health care workers for contracting HIV in the occupational setting was higher than for any other pathogen (Bouvet, Keita, Maiga, Pichard, & Brucker, 1991). In addition, self-reported needlestick injuries were frequent and the practice of safe needle handling was low. Pr. Pichard and his co-authors advised that further research be carried out in order to obtain more valid results. It was also suggested that observational data be gathered to confirm their findings and develop appropriate interventions. Personal interviews with Pr. Pichard and other key informants who participated in the elaboration of the content of the educational program, stressed the urgency to design an intervention study which could meet some of the more immediate needs of Malian health care workers.

In 1991, HIV prevalence in Mali was estimated at one to two percent (Mali, 1994). The latest studies show a progressive increase to five percent and reports of hospitalised AIDS patients continue to climb. A previous study found that the HIV prevalence was 12,7 percent among hospitalised tuberculosis patients at the national hospital Point G (Sangare, Keita, Basse, Maiga, & Fofana, 1991). Recent findings showed the presence of HIV antibodies in 46

percent of 334 blood samples from all types of patients collected at the Gabriel Tourré hospital in Bamako, Mali's capital city (Service, 1997). Of the samples taken from paediatric patients, 25 percent had the presence of HIV antibodies. Other studies indicated (Preble et al., 1994) that the number of HIV positive women attending antenatal care clinics was also on the rise. Given that women in Mali have an average of 7 children and limited access to adequate perinatal care (Unicef, 1989), they are more likely to be exposed to bloodborne pathogens, including HIV, than are men. The National Program on AIDS had identified the importance of developing local educational tools, adapted to the Malian health care context as part of its approach in the battle against AIDS (Mali, 1994). However, this aspect of the strategy has yet to be fully implemented. The additional support provided by this intervention study was thus seen as complimentary to the National AIDS training of trainers workshop designed for a select group of health care workers which had been implemented in each of the seven regions of Mali in 1993 (Sy, A., personal communication, July, 1994). Since this intervention, no reports or follow-up evaluations are available to monitor the effectiveness of the training. The proposed evaluation of an inservice training on universal precautions provided an opportunity to implement additional outreach activities in the capital city, where experts suggested HIV prevalence was highest (Service, 1997).

1.4 Study Partners

The author worked in Bamako, Mali for a two-month period to carry out the field aspect of this study. Previous contacts had been made with government

authorities and local health centre directors before departure. Funding for the project was obtained locally through Save the Children's Fund and the United Nations Children's Fund (UNICEF). The pedagogical component was developed in conjunction with these funding agencies as well as the Programme national de lutte contre le sida du Mali and the Centre de Services de Production Audiovisuel (CESPA), a local audio-visual production company for community development. Central to the success of this project was the collaboration and participation of the administration and staff of four Malian health care facilities. Other Canadian partners who provided technical and research assistance to the project included: the Université de Montréal, the Centre maternel et infantile sur le sida, the Canadian Society for International Health and the Groupe de recherche d'action sur le sida du Centre sida McGill. Many players were thus involved at different levels.

1.5 Study Intervention

1.5.1 Expected Program Outcomes

Objectives for the education program entitled "La prévention de l'infection par le VIH dans les milieux de soins" were based on a general review of the literature using a Medline database search and more specifically, on a previous study reporting high levels of professional exposure to bloodborne pathogens among hospital staff workers in Mali (Bouvet et al., 1991). During the field work phase of the study, the expected program outcomes were revised following informal interviews with Malian health care workers and other local key informants. The program objectives are detailed on the next page.

Figure 1
Expected Outcomes for the Inservice Training Program
on Universal Precautions for Malian Health Care Workers

General Goal:

To decrease the risk of HIV transmission in the Malian health care setting from patient to patient, patient to health care worker, and, health care worker to patient.

Intermediate Objective:

To increase awareness among Malian health care workers of HIV transmission in the health care setting and of the appropriate use of universal precautions.

Specific Objectives:

At the end of the training session health workers will be able to:

1. Cite three modes of HIV transmission.
2. Accurately assess their risk for HIV exposure in the health care setting.
3. Describe five methods to prevent occupational exposure to HIV.
4. Identify three strategies to avoid needlestick exposure.
5. Recognise that precautions are practised universally with all patients.
6. Increase their awareness of unsafe practices that increase patient to patient, patient to health care worker, and health care worker to patient transmissions.
7. Identify barriers in implementing universal precautions in the health care setting.
8. Identify possible solutions to increase the practice of universal precautions in the health care setting.
9. Improve their attitudes in favour of the adoption of universal precautions.
10. Improve their attitudes toward the physical care of HIV positive patients.

1.5.2 Program Design

Proposed guidelines by the World Health Organisation (Santé, 1989) for universal precautions in the health care setting helped lay the foundation for the theoretical content of the inservice program. The four hour training session included information on modes of HIV transmission, occupational exposure risk, universal precautions, guidelines for accidental exposure, high risk practices, and possible solutions for minimising exposure risks. A 23-minute video and an accompanying written guide highlighted each of these elements. The idea was to create sustainable tools which could facilitate consistent replication of information during each inservice. Although Western versions of these tools are available, none of them accurately reflects the Malian context.

Theoretical validation of the training content was obtained through informal observation and interviews with Malian health care workers. It quickly became clear, however, that there was a disparity between the WHO recommendations and what could feasibly be implemented with current resources of Malian health care facilities. Ideas of adaptable technology were used in the video to demonstrate how health care workers might develop ways of routinely implementing universal precautions. It became essential then, that the design of this intervention would not only seek to increase awareness of the importance of the use of universal precautions, but at the same time, generate useful discussion in order to promote practical solutions that could be implemented with locally available resources.

1.5.3 Theoretical Underpinnings of the Program

The choice of teaching methods is an important component in facilitating program objectives. Adult education theory (Allman, 1988) supports the effectiveness of a participative learning environment among adult learners. A comparison of didactic teaching and experiential learning with nursing students in the Philippines (Stiernborg, Zaldivar, & Santiago, 1996) suggests higher levels of knowledge acquisition within groups in which students took part in solving problems. Therefore, to further augment the effects of the inservice, the video and guides were used only as communication tools to further mobilise group discussion.

In developing countries, Freire's popular education movement takes this notion one step further and proposes a type of facilitation in which participants take on the role of experts (Wallerstein & Bernstein, 1988). This approach is considered instrumental for creating an empowering environment for sustainable change. In this instance, the participatory form of the inservice training highlighted brief segments of the video. This was followed by a group discussion with participants who were encouraged to relate their reactions, offer their own experiences, and suggest ideas which could prove useful in their own workplace. This approach gives credence to the philosophy that those involved in the problem are also part of the solution. Consequently, it was particularly important for health workers to recognise themselves in different scenarios and care was taken to ensure that all categories of health care workers were represented in the video. Local health care workers were also consulted about the content of the

education programme, however, study participants did not participate in its design.

The session ended with a general review, including an additional question and answer period, and a summary of key concepts highlighted in the pamphlet. Feedback was solicited at the end of each session in order to make further modifications to both the video and guide. In future inservices, once the final production of the guide is completed, it will be given to participants so that they may leave the training with reference documentation in hand.

1.5.4 Program Implementation

Two Malian facilitators, a doctor and a midwife, were employed by the project to run the three hour long training sessions. Only one centre had the necessary equipment to view the video. CESPAs supplied a television and VCR for the other sessions. One site had insufficient space to accommodate 20 people and participants had to be transported by bus to another centre. Dates and times of the inservice were negotiated with the directors of each site and scheduled at times convenient to health care staff. No financial remuneration was given to the health care workers for their participation since the study was conducted during their regular working hours. A maximum of 25 participants per inservice were recruited in order to create a suitable pedagogical climate during each session. All interested health care workers were invited to attend the inservice. Further discussion on participant recruitment will be discussed in chapter 4.

2. Literature review

The following literature review is divided into five sections. The first examines health care workers' practice of universal precautions in both developed and developing countries. Some authors (Horsman & Sheeran, 1995) argue that such a comparison cannot be made. Nonetheless, the purpose of presenting both perspectives is twofold. Reviewing studies from developed countries provides a basis for exploring concept areas that have yet to be adequately raised in the literature regarding developing countries. At the same time, it also highlights the lack of comparable research available from developing countries where the epidemic is more acute.

The second section of the review identifies four determinants that emerge from the literature and account for the focus of this study. The impact of education programs in modifying these determinants is also explored. In addition, a brief overview of the role of socio-demographic variables is considered. The final portion of the literature review outlines perceived impediments to the practice of universal precautions among health workers.

2.1 Health Worker's Practice of Universal Precautions

Universal precautions are the most current and effective means for controlling the transmission of bloodborne pathogens such as HIV and Hepatitis B virus (HBV) (Beauffoy, 1989; Campbell, 1991; Pugliese & Lampinen, 1989; Santé, 1989). They are utilised by health care workers who are in direct contact with any body fluid visibly contaminated with blood, semen, or vaginal secretions. Urine, faeces, sputum, tears, nasal secretions, sweat and vomit are also

considered potentially infectious, but only if blood is noticeably present. Likewise, precautions with all other body fluids (i.e. amniotic fluid) should be maintained until studies that are more conclusive can confirm the extent of exposure risk.

Health workers who adhere to universal precautions integrate the following measures into their daily practice (Beauffoy, 1989; Campbell, 1991; Pugliese & Lampinen, 1989; Santé, 1989): (1) reduce needlestick exposure, (2) utilise protective barriers such as gowns, masks, and protective eyewear, (3) glove when in direct contact with blood and body fluids, (4) clean, disinfect, and sterilise patient equipment, and finally, (5) handle infectious wastes appropriately. This series of precautions recommended by Health Canada, the Centre for Disease Control (CDC), and the WHO since 1987, is to be practised by all health workers for all patients regardless of whether the infectious status of the patient is known. In many cases it is difficult to ascertain from a simple physical examination or history whether or not a patient carries a bloodborne pathogen, and it is for this reason that the universality component is so essential for the safety of both patients and health care workers alike.

The multicentre Italian study confirms that although health care workers are frequently exposed to bloodborne pathogens, their risk significantly decreases if preventive techniques are applied regularly, consistent behaviours are adopted, and appropriate technology is made available (Ippolito, Puro, & De Carli, 1993). However, evidence suggests that consistent application of the recommended infection control principles among health care workers is low among all levels of health professionals in all areas of the world.

An observational study of a group of surgical residents in the United States working in a trauma room reported only 16 percent compliance with strict universal precautions guidelines (Hammond et al., 1990). Another study in an emergency department observed that 74 percent of the workers used gloves appropriately, yet contrary to recommendations, needles were recapped 51 percent of the time. Five percent of all needles were left at the patient's bedside or thrown in a general waste receptacle rather than being disposed of in an appropriate container (Henry et al., 1992). Other researchers in Canada, the United States, and Australia have reported similar findings with regard to unsafe needle handling (Dajczman, Dascal, Orenstein, & Frank, 1992; Henry et al., 1994; Hersey & Martin, 1994; Nielson, 1988). Consequently, needlestick injury is the most common exposure incident among health care workers (Kopfer & McGovern, 1993; Rosenberg, Becker, & Cone, 1989). It is also the most effective route for occupational transmission of bloodborne infections such as HIV.

A comparison of health care workers' observed and self-reported practices indicates that study participants tend to overestimate their reported use of universal precautions. Research done on perioperative nurses noted 84 percent of those questioned reported regular handwashing after each patient contact even though an earlier observational study of the same nurses demonstrated a lower compliance rate of 41 percent (Ronk & Girard, 1994). Likewise, a study of emergency room personnel found a general tendency to overestimate the true level of adherence to universal precautions (Henry et al., 1992).

Although there are comparably fewer studies available on health care workers' adherence to universal precautions in developing countries, evidence points to an even lower rate than that observed elsewhere. A study done in 1991 at the national hospital in Mali (Bouvet et al., 1991) reported a 43 percent lifetime incident rate of needlestick injury among health care workers. Seventy-one percent of these health care workers reporting such an incident stated that one had occurred in the past year. Another 27 percent reported two needlestick exposures during the same period. Sixty-eight percent of those workers questioned systematically recapped the needle after giving an injection while another nine percent reused needles and syringes. In all likelihood, however, these percentages underestimate actual practices since data were self-reported.

In Latin American studies, results show that the regular use of universal precautions is also limited. Health care workers in a Mexico hospital recapped needles 57 percent of the time and used gloves only 34 percent of the time (Garcia et al., 1992). In a Dominican Republic study, blood was not removed from 73 percent of emergency room beds (report did not specify on mattress or sheets) before the next patient occupied the bed (Koenig et al., 1992). In addition, glove use among their hospital personnel was limited in spite of their availability.

In a Nigerian self-reported survey of resident doctors, 93 percent reported one or more exposure incident (Olubuyide & Olawuyi, 1995). Of these, 17 percent cited recapping needles as the cause of the exposure, 14 percent cited suturing, installing intravenous lines accounted for 11 percent, and scalpel and

phlebotomy related activities were cited respectively in nine percent of the cases. Seventy-four percent of the respondents questioned admitted using universal precautions 50 percent or less of the time.

After a study in Ghana identified infection as one of the major causes of maternal mortality (Cronin et al., 1993), an investigation of obstetric infection control practices was undertaken with the aim to design an education program adapted to the working conditions of health care workers. Investigators found that because most midwives and nurses do not adhere to infection control procedures, pregnant women are at risk for nosocomial infections as a result of their increased exposure to bloodborne pathogens during perinatal interventions. In view of the fact that many traditional birth attendants are trained by these very same health workers, the extent to which infection is controlled during home deliveries and other traditional practices (i.e. excision) has also been queried.

The consistent application of universal precautions is an important concern, affecting the safety of health care workers and patients alike. Although adequate research has yet to be undertaken in this area, several studies have demonstrated that health care workers engage in dangerous practices which may place patients and themselves at risk for HIV exposure.

The most notable case study was done in the USSR in 1988 (Gromyko, 1990) where hospitalised children were being treated for various illnesses, including one child who was unknowingly HIV positive. Health workers administered medication using the same unsterilised syringe to many children and consequently very likely transmitted HIV to other paediatric patients.

The Ebola virus outbreak in a Zaire hospital is another example of how health workers can act as potential vectors for transmitting infection (Anonymous, 1995; Sepkowitz, 1996). Inadequate sterilisation of syringes was also found to be the cause of transmission. Fortunately, the infection was contained by quarantine measures and its spread was quickly halted. However, if health care workers fail to take adequate precautions in endemic areas of the world where bloodborne viruses such as HIV are on the rise, nosocomial transmission is less likely to be as effectively controlled.

A report of overseas missionaries working in sub-Saharan Africa (Lange & Frame, 1991) documented that 42 percent of the North American mission boards acknowledged that disposable injection materials were frequently reused. Recommendations to reduce HIV exposure among missionaries included less dependence on indigenous Third World health care systems, provision of a walking blood bank, and greater adherence to universal precautions.

Activities practised in the informal health sector of developing countries also pose potential risks that have yet to be accurately evaluated (Berer, 1993). Lay "doctors" with little if any formal training travel from village to village and "specialise" in giving injections to their clients while often reusing the same syringes and needles. Currently, there are no monitoring mechanisms to ensure adequate sterilisation of their injection equipment. Further, parenteral treatments are often preferred over oral medications, since injections are thought to be a more effective cure (Gilson, Alilio, & Heggenhougen, 1994). Some clients

continue to believe that if the medication costs more and hurts more it is also a superior treatment option regardless of its recognised therapeutic effects.

Other lay people also use a variety of instruments to perform ritual practices such as clitoridectomies, circumcision, scarification, and tattooing. A study in Senegal has not linked these practices to the presence of HIV infection, at least in rural areas (Kane, 1990). However, it is important to point out that this article failed to mention HIV prevalence rates in the studied region. In contrast, researchers in Ethiopia did report a positive correlation between hepatitis B infections and traditional practices but did not specify which of these rituals were more likely to increase exposure risk (Committee, 1989). Likewise, a study in Zaire found an increase in HIV transmission among those who took part in scarification rituals (Fleming, 1990).

These practices are not unique to rural settings. To supplement their limited income, many urban health care workers concurrently exercise their practice in both formal and informal sectors (Berer, 1993) using their own personal medical equipment. In addition, they may offer treatment supplies, such as injection equipment, at a reduced price to families with limited means even though such equipment may have already been utilised and has not necessarily been adequately sterilised. In view of the fact that most of these acts are practised in the health care setting where health care workers perform most of the invasive treatments and procedures, this work focuses on examining those determinants which influence the application of universal precautions in this context.

2.2 Determinants Influencing the Practice of Universal Precautions

Before introducing the discussion on the determinants that influence health care workers' practice of universal precautions, it is important to highlight two opposing views with regards to infection control. Some authors have suggested that health care workers cannot change, but rather, it is the environment that should be modified in order to make a safer place in which to work (Turner, 1993). One suggested change includes mandatory HIV testing for all hospitalised patients. However, as Gerberding (Gerberding, 1991) points out, this is not necessarily cost effective in areas of low HIV prevalence. Furthermore, the financial weight of such an option remains unbearable for most developing countries.

Other strategies promote the development of special devices, such as sharps containers and needleless intravenous equipment, which are designed to minimise health care worker exposure to injection materials. Opponents of this view argue that the behaviour of the health care worker should be addressed. By drawing on appropriate researched theoretical frameworks, relevant intervention programs could be implemented. However, in practice, few studies, have used a theoretical approach to improve health care worker compliance with universal precautions (Horsman & Sheeran, 1995).

Both schools contribute to the promotion of a broader view of universal precaution use in the health care setting. Health care workers function in a variety of situations and have various levels of access to supplies. For example, home care programs, inner city hospitals, rural health care centres in both

developed and developing countries have each their respective resource allocation, which may or may not meet client demand. In addition, availability of training and information may differ. These inequities represent important obstacles which cannot be neglected.

An ecological approach takes into account the complexities encountered in health care workers' practice of universal precautions in the health care setting, particularly in developing countries. This paper is further guided by the perspective which empowers individuals to act on their environment in order to facilitate change (McLeroy, Bibeau, Steckler, & Glanz, 1988). The desired change is not entirely dependent on either the individual or the environment but rather on their interaction. With the emergence of HIV and other bloodborne pathogens, a web of factors influencing his or her adoption of consistent universal precautions use guides the individual health care worker's response.

Green, Richard, and Potvin (1996) propose some practical guidelines for integrating the ecological perspective in health promotion evaluation and identifying prime targets for improving the well being of a population. These targets may be aimed at either the individual or the environmental level. In this study, the chosen target areas are the individual behavioural determinants of Malian health care workers' adherence to universal precautions practice in the health care setting. The determinants that will be addressed in this section include perceived susceptibility to HIV exposure, knowledge of the modes of HIV transmission, knowledge of universal application of precautions, and knowledge of needlestick exposure prevention.

Although the literature review focuses mainly on concepts pertaining to the individual, it does not assume that the environment is less important. Challenges related to the environment are raised in relation to health care workers' behaviours and will be discussed during the latter part of this review. Indeed, it is important to keep in mind the dynamic environmental context of Mali's health care system in order to have a better grasp of health care workers' behaviour. Failing to do so limits the possibilities of understanding the scope of the problem as well as finding the most effective solutions.

2.2.1 Health Care Workers' Assessment of Occupational Risk of HIV in the Health Care Setting

Actual exposure rates to human immunodeficiency virus (HIV) infection in the health care setting are reported to be in the range of 0.3-0.5 percent (Ippolito et al., 1993; Roy & Robillard, 1995). Surprisingly, studies done in developing countries report similar findings (Dixon, Bertrand, McLean, Tousignant, & Groome, 1992; Marcus, Kay, & Mann, 1993b; Rodts & Girard, 1992). Findings from a Brazilian hospital estimated health care workers' occupational risk of acquiring HIV infection at 0.4 percent (Cavalcante et al., 1991). Yet studies in Uganda have revealed that as many as 30 percent of health care workers are infected with HIV. Although the sources of transmission have not been identified, these figures give rise to further inquiry. Additional consideration of this issue is essential given that approximately ten percent of all HIV transmission in Africa is estimated to be related to unsafe blood transfusions (Berer, 1993) and that needlestick injury is the most commonly reported occupational injury among

health workers (Lague, 1995). Over and above these risks, mathematical models (Aylward, Kane, McNair-Scott, & Hu, 1995) have demonstrated that if a health care worker reuses a needle and syringe four times in an HIV prevalence area of 1 percent, HIV infection may be transmitted between 14 to 35 cases per thousand women receiving injections. These calculations do not even include vial contamination, which would further increase the threat of transmission.

These findings have serious implications for patients as well as those health care workers who are manipulating these same unsterilised needles. Yet official reports confirm only three occupational acquired HIV cases among health workers on the entire African continent, all of whom are from South Africa (Roy & Robillard, 1995). Such contradictory evidence leads us to more questions than answers and highlights the need to further explore occupational HIV transmission in the health care setting.

There are several reasons why the description of the HIV epidemic among health workers in developing countries is far from clear. Some researchers (Kelen, 1990) question the methodological strength of studies done in developing countries and suggest that any calculations of occupational HIV transmission underestimate the true risk. Confirmation of all potential cases is difficult in many countries. According to Kelen (1990), the required criteria that need to be documented before a case of nosocomial HIV transmission can be declared are almost impossible to collect. These include: «a documented exposure with the source proven to have HIV, seroconversion demonstrated in the exposed health worker, full epidemiological profile of the health care worker, absence of risk

factors established not only for the health worker but also for all sexual contacts in the past, no intervention exposures or risk behaviours before demonstration of seroconversion, and the case be either published or brought to the attention of public health officials (p.244) ». Unfortunately, many countries still do not have this type of surveillance for occupational exposure and many incidents continue to go unreported (Olubuyide & Olawuyi, 1995).

Even where such mechanisms are in place, systematic reporting of exposure is not necessarily commonplace. On the one hand, many health centres do not have a formal system of procedures for workers to report occupational accidents. On the other hand, health workers' perceived risk of HIV exposure might also influence reporting patterns. In a study of a group of residents, 65 percent of those questioned did not perceive their accidental exposure as a health risk, 25 percent were not aware of the reporting procedure, 17 percent were too embarrassed to report the exposure, 17 percent were concerned about confidentiality, and another 17 percent were concerned about occupational discrimination (Hoffman-Terry, Rhodes, & Reed, 1992).

Likewise, a Canadian study (Dajczman et al., 1992) conducted in a Montreal hospital in which 28 percent of the health workers were non-compliant with universal precautions found that 41 percent of those who did use universal precautions applied them based on their assessment of risk exposure. Yet, in an observational study carried out in Miami by U.S. researchers, adherence to universal precautions did not improve despite the fact that health care workers were aware that they were caring for high-risk patients (Hammond et al., 1990).

In general though, most researchers have (Talan & Baraff, 1990; Wiley et al., 1990) observed that non-compliance increases as the perceived risk decreases.

Meanwhile, Cavalcante et al. (Cavalcante et al., 1991), found that health workers at a hospital in Brazil perceived their work to be at high risk for HIV infection exposure, but unlike findings from western countries, there was no evidence to suggest an increase in compliance. Similar findings were reported in Mexico (Garcia et al., 1992). There are unfortunately few studies in developing countries that have examined the relationship between health care workers' assessment of occupational risk and their subsequent compliance with universal precautions. It remains clear that the notion of risk is a recurrent theme in the literature, however its impact on universal precaution practices among health care workers remains equivocal.

2.2.2 Health Care Workers' Knowledge of HIV Transmission

The role of knowledge has been widely studied in health education literature. Most researchers agree that knowledge is a necessary but not a sufficient component to promote behaviour change ((Rudd & Glanz, 1990). However, without accurate knowledge of currently available health promoting practices, it is unlikely individuals can attain or maintain an optimum level of health.

Social learning theory contends that the behavioural capability of the individual is based on two essential components: knowledge of the behaviour and the skills associated with the performance of the behaviour (Perry, Baranowski, & Parcel, 1990). It can therefore be posited that an essential

element of the health care worker's consistent practice of universal precautions is based on accurate knowledge of HIV transmission. In addition, knowledge has been shown to be positively associated with health care workers' comfort levels in working with people living with AIDS (Pomerance & Shields, 1989).

Although knowledge of HIV among health care workers has been widely addressed in the literature, there exists many disparate research findings (Horsman & Sheeran, 1995). Overall, HIV knowledge levels of health care workers are high. However, results are often too vaguely reported, making it difficult to ascertain which aspect of HIV knowledge is being measured. Differences and inadequacies in research methodologies present other obstacles. Some of the difficulty arises from researchers who have used unvalidated measurement instruments, insufficient sample sizes, and inadequate research methodologies, which fail to control selection and observation biases. These weaknesses alert readers to avoid comparing results among different studies and to withhold judgement on establishing any valid conclusions.

With this in mind, the literature still raises several points that bid for further inquiry. The most significant of these, deals with knowledge levels in relation to the prevalence of HIV and AIDS. In developed countries where the prevalence of HIV infection is low, knowledge levels with regards to HIV transmission are generally low. The reverse also holds true. When the number of HIV and AIDS cases rise, knowledge levels of health care workers increase. One national survey of registered nurses found a positive relationship between self-reported

compliance with universal precautions, risk perception, exposure to HIV infected clients, and comprehension of HIV/HBV transmission routes (Wiley et al., 1990).

The literature of developing countries tells a different story. Although there are few published studies available, higher HIV and AIDS prevalence rates do not appear to influence health workers' knowledge of HIV transmission. A study of 200 health care workers in Nairobi, Kenya found that 31 percent of those responding to an anonymous questionnaire believed that HIV could be transmitted by mosquito bites, 70 percent by kissing, and 43 percent by nursing a patient (Bowman, Rogstad, Ahmed, Tesfaledet, & Abdullah, 1992). Another study of 50 surgeons in India reported poor HIV knowledge levels, but offered no detail as to the specific areas.

Contrary to these findings, are the results of a standardised pre-tested questionnaire administered to an unreported number of Nigerian medical students (Oibogun, 1993). Here, 100 percent of the respondents were able to cite all of the four most common routes of HIV transmission: sexual intercourse, blood transfusion, injection via needles, and mother to child.

Still, some of these results may not accurately provide a complete picture of knowledge levels among health care workers. Researchers in China noted that although 90 percent of Chinese medical students identified the modes of HIV transmission correctly, only 72 percent were able to correctly identify how HIV was not transmitted (Li, Cole, Zhang, & Chen, 1993).

A comparison of Zimbabwe and United States (U.S.) nursing students showed higher knowledge levels among US students (Munodawafa, Bower, &

Webb, 1993). Twenty-six percent of Zimbabwe students stated it was possible that HIV could be transmitted by being in the same room with infected clients. None of U.S. students thought this was a likely means of HIV transmission. Although U.S. students scored higher in the area of transmission, 7 percent felt that it was very likely to contract HIV by sneezing and coughing compared to 19 percent of Zimbabwe students. When asked if working with specimens of blood or urine could transmit HIV, ninety-three percent of Zimbabwe students reported that it was «very likely » compared to only seventy-eight percent of US nursing students. Some of the discrepancy could be attributed to the wording of questions asking for an overall interpretation of different levels of transmission risk associated with two different biological substances. Nonetheless, Zimbabwe students were more inclined to overprotect themselves and quarantine AIDS patients than were US nursing students.

2.2.3 Health Care Workers' Knowledge of Universal Precautions

Knowledge of universal precautions is beginning to claim greater attention in the literature as the HIV and AIDS pandemic sparks renewed interest in infection control within the health care setting. One of the main knowledge deficits among health care workers appears to be the lack of recognition that all clients should be considered potentially infectious regardless of their HIV status. Many authors maintain that knowledge of this principle is fundamental to the universal practice of universal precautions among health care workers (Hoffman-Terry et al., 1992; Ronk & Girard, 1994).

Indeed, many health care workers tend to underestimate the level of risk among apparently healthy looking patients (Marcus et al., 1993a). One study in an industrialised country found that only 39 percent of 901 health care workers from a secondary and tertiary care hospital understood the potential for any patient to be infected (Kristensen, Wernberg, & Anker-Moller, 1992). Talan and Baraff (Talan & Baraff, 1990) also noted that emergency personnel underestimated the risk of HIV transmission from patients even among patients who were known to be infected with HIV. The authors of this work further emphasised that for every AIDS patient brought to the emergency room, there is a corresponding estimate of ten asymptomatic HIV-infected patients.

A Canadian study reported that health care workers relied heavily on patient appearance in order to decide which precautions they should adopt (Dajczman et al., 1992). Likewise, 50 percent of trauma personnel cited patient appearance as their reason for non-adherence to universal precautions. Moreover, a study of circulating operating room nurses found that 94 percent of those questioned were familiar with universal precautions, yet 80 percent said they changed their habits only when they knew their patient was HIV/HBV positive (Ronk & Girard, 1994). This contradictory evidence clearly highlights the gap between health care workers' knowledge of the basic premises of universal precautions and risk perceptions.

Similar patterns are also reported in developing countries such as in Brazil where only 53 percent of emergency nurses approached each patient as if he or she were potentially infectious (Sampaio & Figuieredo, 1992). Many health care

workers still seem to think that they can detect HIV infected clients through simple observation. A study in Rwanda found that even with symptomatic patients, this was not the case, highlighting the difficulties health care workers have in recognising patients with AIDS-related signs and symptoms (Harms et al., 1994). Reliance on the physical assessment of patient's HIV status may provide health care workers with a false sense of security.

The link between knowledge of universal precautions, its practice, and exposure risk (Kristensen et al., 1992), is highlighted in a study carried out in Denmark. There, health care workers who had knowledge of and adhered to universal precautions practices had significantly lower rates of contact with blood than those health workers who did not. Gerberding (Gerberding, 1991) supports this relationship and brings forth the hypothesis that health care workers practising in high HIV prevalent areas perceive themselves to be at higher risk of infection and have more incentive to increase their understanding and practice of universal precautions.

Knowing when to use universal precautions is as important as knowing how. Knowledge of the correct procedures for implementation of universal precautions is an essential element for their successful use. The literature highlights that unsafe needle handling among health care workers is the most serious breach of all universal precautions procedures (Dajczman et al., 1992; Hersey & Martin, 1994; Olubuyide & Olawuyi, 1995). Thus, it is not surprising to find that needlestick injury is the most effective route for occupational transmission of bloodborne pathogens such as HIV (Shields, 1994). CDC

guidelines recommend that needles not be recapped after injection and that they be immediately disposed of in a specifically designated container readily available to health care workers.

Yet, as discussed earlier, recapping practices remain commonplace in the health care setting (Dajczman et al., 1992; Hersey & Martin, 1994; Olubuyide & Olawuyi, 1995). A US study of four hospitals concluded that this is a result of inadequate knowledge of correct needle disposal procedures (Becker et al., 1990). Gruber et al. (Gruber et al., 1989), however, found no relationship between universal precautions knowledge and practice but still agreed that basic knowledge was essential. Furthermore, they suggested that psychosocial and motivational aspects should be emphasised in educational programs in order to promote greater adherence to universal precautions practices.

2.3 Effects of Universal Precautions Education Programs

Many researchers have underlined the importance of education in efforts to increase health care workers' utilisation of universal precautions (Fahey, Koziol, Banks, & Henderson, 1991; Gibson, Mathias, & Epstein, 1995; Gruber et al., 1989; Kelen, 1990; Sokas et al., 1993). There is, however, conflicting evidence to support the use of staff inservices as an effective means for increasing adherence to universal precautions practice (Levin, 1995). Most investigators concur that ongoing training programs improve health care workers' knowledge levels of HIV transmission and universal precautions and that these elements are important precursors for the consistent practice universal precautions (Wertz et al., 1987).

There have been reports that training has directly influenced the frequency of health workers' practice of universal precautions (Stiernborg et al., 1996). However, Levin's (Levin, 1995) review of the effectiveness of educational interventions in improving the practice of universal precautions suggests that any conclusion favouring the success of such programs are premature. Her claim is supported by the lack of solid evidence found in most research findings. Attempts to evaluate the effects of education are weakened because of the use of non-experimental study designs, problems with statistical power, and a lack of internal and external validity.

There is also a lack of agreement with regards to the duration of the effects of the training. Wertz et al. (1987) noted continuously high levels of knowledge and attitudes even one month after the initial training. On the other hand, most of the evidence points to the limitations of time-limited education efforts over time. Findings from a universal precautions training evaluation showed an increase in universal precautions use among students after the implementation of the program, but this progress was short lived (Doebbeling, Li, Lansing, Knudson, & Albanese, 1992). Once students began to work among other health care workers, they imitated the same low adherence level as their peers.

Another study (Sokas et al., 1993) found that training can considerably improve students' knowledge levels as well as their feelings of competency but failed to measure these tendencies over time. Talan and Baraff (Talan & Baraff, 1990) noted only a moderate change in compliance after implementing their one

time education program, but noticed no long-term change in the health worker's knowledge of HIV risk.

Another study among surgical staff members (Courrington et al., 1991) found no significant differences in observed compliance rates after a one-time-education effort. Furthermore, multiple training sessions did not appear to have an impact on non-adherence (Dajczman et al., 1992). Yet others (Fahey et al., 1991) have reported a significant increase in health worker's adherence to universal precautions after training, although exposure was not entirely eliminated.

Amidst all this opposing evidence, there is a clear need to evaluate education strategies as part of an integral institutional and employee commitment to infection control. Most authors highlight that these education programs need to be continuously adapted and re-evaluated based on the type of work performed as well as the specific needs of each particular institution. For example, an Australian study observed greater success with ongoing safe working practices when counselling sessions for health care workers were provided immediately after an occupational exposure incident (Boswarva, 1992). On the other hand, one-time pre-incident training programs appeared less beneficial than this approach.

The educational interventions evaluated in many of the studies are as varied as the effects that have been obtained (Levin, 1995). Nonetheless, certain strategies appear to be more promising than others. In India, an evaluation of a two-day training program on AIDS found that knowledge levels

among the 105 nurses rose from 7.6% in pre-training to 51.4% in post-training (Dutta, 1994). Given the apparent success of the program, the authors of this study recommend that similar training be included in all nursing continuing education programs and student curricula.

In many countries, training of health care workers in universal precautions is viewed as an institutional responsibility under occupational health and safety requirements (DeFilippo, Bowen, & Ingbar, 1992). However, some institutions have adopted training of trainers workshops rather than directly offering inservices to all of their personnel. This strategy has gained popularity because it is thought to have a greater multiplier effect among peer health care workers, and thus, is seen as being more cost efficient. However, results of these experiences are uncertain since they are too often reported anecdotally instead of by sound research based articles.

The Nigerian and Indian health authorities in collaboration with international non-governmental organisations, have tried to address HIV/AIDS education among health care workers in this manner (Dhaulta, 1994; Webster & Nnabugwu, 1993). Authors of both these reports acknowledge that these workshops are necessary and at the same time offer several recommendations for future replication of such initiatives. This is puzzling since many questions regarding the effectiveness of this type of intervention remain clearly unanswered. Some of the issues that would need to be addressed include the high financial and human resource commitments for these activities. Participants are often expected to develop programme objectives that, in turn, are to be

implemented with limited financial support. Likewise, there is an unrealistic responsibility placed on participants for following-up on these workshop-made commitments, without having had the opportunity to discuss the objectives with their colleagues and supervisors. Finally, the condensed transfer of information in a weeklong intensive course, apart from their workplace, only brushes the surface of multiple content areas. These concerns signal an important call to evaluate potentially squandered efforts.

In 1993, the Malian National Program for Aids also attempted to organise regional training workshops for health care workers which covered many HIV/AIDS care issues including infection control procedures (Sy, A., personal communication, July, 1994). Participants were to act as trainers upon their return to their respective health centres but no continuous follow-up or evaluations have been done to study the effectiveness of this strategy. In short, many studies have addressed the effectiveness of education programs on increasing adherence to universal precautions in North America, yet there are few published findings documenting the particular challenges associated with implementing such programs in developing countries.

2.4 Relationship between Socio-Demographic Variables and Universal Precautions Practice

Additional variables such as the health care worker's gender, age, type of centre, type of health care worker, type of department, years of employment, and number of previous HIV training sessions may potentially influence their practice of universal precautions. With regards to gender, most studies have established

that gender is not an influential factor (Krasnik, Fouchard, Bayer, & Keiding, 1990). Other variables, however, seem to play a role at varying degrees.

An association between health care workers' adherence levels and previous exposure to universal precautions training seems to exist. Although in one study this was only true of glove use while all others forms of barrier control demonstrated no significant differences in practice (Williams, Campbell, Henry, & Collier, 1994). However, health care workers with less training tended to recap needles more frequently.

In reference to the number of years of experience, a study of nurses who had worked six to 10 years reported that they were less familiar with universal precautions than nurses with less than one year's experience. (Ronk & Girard, 1994). The authors of this study suggest that this is a result of increased training in universal precautions received by the new graduates. Li (1992) also found that knowledge levels among medical students were ten percent higher than among working health professionals. Other findings reported that older health care workers have lower knowledge levels of HIV transmission than their younger colleagues (Gemson et al., 1991). In contrast, another study found a positive relationship between level of knowledge and age (Klimes, Catalan, Bond, & Day, 1989).

The level of education appears to influence health care workers' knowledge levels in some studies. Doctors are reported to have higher levels of knowledge than other health care workers (Henry, Campbell, & Willenbring, 1990; Krasnik et al., 1990). Henry et al. (1992) also found that physicians used

gloves more regularly than nurses and nursing assistants. In addition, physicians recapped needles less frequently than nurses did. Yet in a Dominican Republic study, none of the doctors or nurses used gloves to draw blood (Koenig et al., 1992) and 62 percent of housekeeping staff in the operating room did not use gloves. Wertz et al. (1987) observed that HIV and AIDS care policy makers are more knowledgeable than those who implement these same policies. The authors conclude that these findings further support the need for additional training among all health care workers.

Some studies have reported that the department where the most reported exposure to blood occurs is the infectious disease ward (Cavalcante et al., 1991; Ippolito et al., 1993). In contrast, another study indicated that surgical residents faced three times the risk of accidental exposure than did medical residents (Olubuyide & Olawuyi, 1995). Exposure to sharps was also greater on critical care units than on medical wards (Lyons, Gerardi, & King, 1992).

Many of the relationships raised above are based on pre-intervention data. One study sought to examine if similar patterns were observed after health care workers attended an educational program, which lasted four to eight hours (Allender, Senf, Bauman, & Duffy, 1991). Researchers found that socio-demographic characteristics significantly influenced knowledge and attitude scores in pre-training results. However, this was not the case in post-training results where comparable levels of change were observed regardless of the participants' characteristics. Authors suggest this is good news since it shows that different categories of health care workers can equally benefit from attending

similar types of AIDS education inservices even though there were initial differences.

2.5 Other Factors Influencing Universal Precautions Practice

Cited reasons for lack of adherence to universal precautions are the health care workers' attitude that it will not happen to them, forgetfulness, lack of time, and interference with dexterity (Hammond et al., 1990; Henry et al., 1992; Meyer, 1993; Williams et al., 1994). Some of the cited environmental barriers include cost, lack of institutional and peer support, scarcity of supplies, and insufficient educational opportunities.

2.6 Economic and Political Obstacles Influencing Universal Precautions Practice

Many of the challenges in implementing universal precautions are amplified in developing countries where HIV infection prevalence rates are higher and health care resources are fewer (Gates, 1992). A two month observational study among Ghanaian nurses and midwives (Cronin et al., 1993) found that gloves, needles and syringes were systematically reprocessed since adequate supplies were unavailable. Moreover, the injection equipment was cleaned only 70 percent of the time, and, solely with water. Although strongly discouraged by the WHO, many countries continue to sterilise and reuse syringes and needles that are designed for single use only (Cronin et al., 1993).

The inability of government institutions to adequately fund the health care sector impacts on the daily lives of those who seek medical attention (Preble et al., 1994). A development aid worker in Uganda (Anonymous, 1994) observed

that patients frequently brought their own gloves for health care workers to use. In Mali, some facilities ask pregnant women to bring gloves for the midwives to use during the delivery (Korotoumou, M., personal communication, July, 1994). Others (Cavalcante et al., 1991) have also noted that the hospital's budget restrictions are a barrier to consistent application of universal precautions. As countries try to implement health care reform, staff members are fewer and overworked. This contributes to an increased risk of occupational exposure to bloodborne pathogens (Nashman, Hoare, & Heddesheimer, 1990) which in turn decreases retention rate of health care workers, adding further stress to the health care system (Buvé, 1994).

3 Conceptual Framework and Research Hypotheses

Horsman and Sheeran (Horsman & Sheeran, 1995) provide a critical review of health workers' knowledge and attitudes toward HIV and AIDS and those living with it. Their findings reveal that most studies lack theoretical guidance. They caution however, that their findings cannot be generalised to developing countries where HIV and AIDS bear different cultural meanings and where resources are significantly smaller in proportion to the magnitude of the epidemic. Nonetheless, even in light of the scarce amount of studies on this subject matter, similar patterns emerge from developing countries.

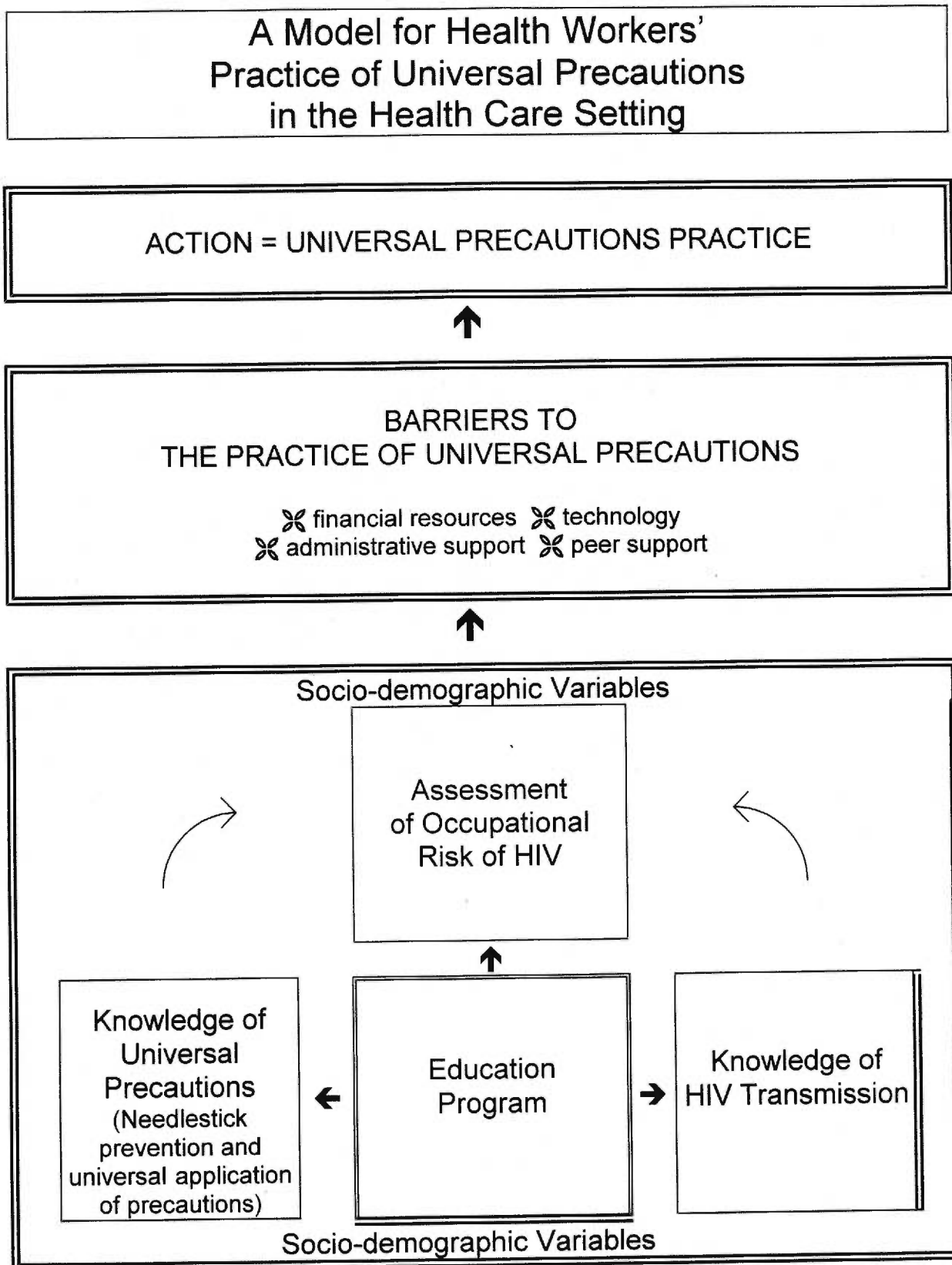
In like manner, this particular research study is open to such criticism. Although the initial review of the literature provided some assistance in determining the objectives of this study, it was not until after the intervention was completed that the research questions and conceptual framework were more

clearly refined. For this reason, only the aspect pertaining to the education program of the model (c.f. figure 2) has been addressed in this study. The remaining theoretical constructs may be helpful in describing the complexities of the context faced by Malian health care workers and offer insight into the multiple determinants influencing their practice of universal precautions. These efforts may subsequently be useful in generating research questions for future study.

3.1 Conceptual Framework

The conceptual framework for this study is divided into two main areas which are thought to promote health care workers' practice of universal precautions (cf. figure 2). The first explores the level of improvement of worker's general knowledge of the modes of HIV transmission, knowledge of universal precautions (including needlestick prevention and universal application of precautions), and assessment of occupational risk to HIV exposure after an education program. These concepts have been repeatedly discussed in the literature and are considered important building blocks for improving health worker practice of universal precautions. This section of the model further illustrates the relationship between risk assessment and knowledge as well as the influence of socio-demographic variables on each of the concept variables. The second area, the environmental component, provides an essential link to the desired outcome of universal precaution practice. It is a vital piece to this framework and includes elements such as financial resources, technology, administrative support, and peer support.

Figure 2



3.2 Research Hypotheses

The hypotheses for this research are outlined as follows:

- 1) Participation in an education program for the prevention of HIV infection in the health care setting will increase health care workers' accuracy in assessing occupational risk of HIV.
- 2) Participation in an education program for the prevention of HIV infection in the health care setting will increase the level of the health care worker's general knowledge of the modes of HIV transmission.
- 3) Participation in an education program for the prevention of HIV infection in the health care setting will increase the level of the health care workers' knowledge of universal application of precautions.
- 4) Participation in an education program for the prevention of HIV infection in the health care setting will increase the level of the health care workers' knowledge of prevention of needlestick exposure.
- 5) There is no relationship between participants' socio-demographic variables and an increase in knowledge and risk perception after attending an education program.
- 6) There is no relationship between health care workers' knowledge levels and their assessment of their occupational risk after participating in an education program.
- 7) Participation in an education program will assist the health care worker in identifying barriers to the practice of universal precautions.

4. Method

4.1 Study Design

Practical considerations were the main impetus for choosing a pre-experimental, non-randomised, prospective pre-test/post-test design. Ideally, a randomised experimental design would have been more appropriate to confirm the hypotheses of this study. However, in light of the logistical, financial, and time considerations associated with working a continent away, this approach was not feasible at the time of the study. Availability of a control group required additional financial and time resources. In addition, many of the study's objectives were revised after further contact with key informants upon arrival at the study sites in Mali. It quickly became difficult to juggle expectations of the funding agencies whose focus were to complete the pedagogical tools and implement the training while maintaining a rigorous research strategy in a dynamic cultural context. This study can therefore be considered an exploratory look at Malian health care workers' knowledge of HIV transmission, knowledge of universal precautions, and perceived susceptibility to HIV exposure before and after the implementation of an education program. To be sure, this knowledge is limited to the study population, but could nonetheless be valuable in directing future research and intervention efforts in Malian health care settings.

4.2 Study Sites

Four facilities were chosen to represent different organisational levels of the Malian health care system. These included a national health facility, a city health hospital with high trauma and acuity, a central maternal/child health clinic, and a local co-operative community health centre. Each of these sites is located in the capital city of Bamako. They were chosen for their wide range of patient contact, their acceptance to partake in the elaboration of the pedagogical tools, the willingness of staff to take time off to attend the training session on universal precautions, and each site's participation in the subsequent evaluation of its effects.

4.3 Study Participants

A convenience sample of 82 Malian health care workers and students participated in the baseline study testing and a total of 58 completed the post-test. Five training sessions were held; one at each health care facility and an extra offered at the national hospital due to the demand. Each session consisted of 15 to 24 participants.

There was only one inclusion criterion. Participants were required to have a job description that included potential exposure to blood and sharps equipment. An estimated 640 health care workers were eligible to participate during the study period between August 29 to September 1, 1994. They included physicians, midwives, nurses, lab technicians, nurse's aides, and orderlies. There was no active recruitment of students. However, those doing their practicum at the time of the intervention were not excluded from the study.

Given the sensitive nature of discussing HIV transmission in the workplace, voluntary participation was favoured. Although this significantly increased selection bias, choosing health workers at random raised concerns among some authorities (Pichard, E, personal communication, June, 1994). There was fear that health workers' would feel that their behaviour was targeted. Consequently, this could decrease their willingness to participate in the study and possibly create mistrust toward the intervention. Given the preliminary nature of this exploratory study, it was considered important to include all categories of health care workers wishing to partake in the study. Moreover, since the issues raised were common to all workers practising in the health care setting, this inclusive approach would facilitate the exchange of concerns and ideas.

Supervisors for each of the study sites were approached by the study organisers several weeks before the inservice to discuss participation of personnel at the sessions. Supervisors were responsible for identifying which personnel members were available to attend the inservice. Times for the inservices were chosen by supervisors in order to limit disruption to the service and promote high levels of staff participation.

4.4 Dependent Variables

Four dependent variables were examined in this study: health workers' accuracy in assessing their occupational risk to HIV, knowledge of the modes of HIV transmission, knowledge of universal application of precautions, and knowledge of prevention of needlestick exposure. These outcomes were

measured using indices that were developed from baseline questionnaire item responses.

All questionnaire answers were coded one for correct answers. Incorrect or non-cited responses were coded zero. All missing, incorrect, and « don't know » data were also coded zero. Inverted questionnaire items were recoded accordingly to ensure correct interpretation. The 3 Likert categories that agreed were grouped together and desirable responses were coded one. Four indices were created on the basis of data collected from the baseline sample population. Each of these indices was defined by examining frequency distributions of questionnaire responses as well as inter-item correlations. Cronbach's alpha coefficient was used to determine adequate reliability of each of these composite test scores.

With regards to the health care workers' accuracy in assessing their occupational risk to HIV, a 3-item scale found a coefficient alpha of .51. The second concept, general knowledge of HIV transmission, combined the answers of six questionnaire items and obtained a coefficient of .57. The index of knowledge of universal application of precautions was constructed using the responses of four questions with an alpha of .50. Finally, the concept of knowledge of prevention of needlestick exposure used three questions and yielded a coefficient alpha of .56. The classification of these questions can be viewed in figure three on the following page.

4.5 Independent Variables

Conditions which may influence the outcome variables of this study include the following socio-demographic data collected from the baseline questionnaire: gender, age, work site, occupation, department, number of years employed, and number of past training sessions. In light of the limited sample size, alike categories were grouped together within each socio-demographic characteristic in order to facilitate analysis and interpretation of findings. With the exception of the variables age and gender, categories were determined after the data collection. The variable age was divided into three categories: 20 to 29 years, 30 to 39 years and 40 years and over. The 50 years and over classification category was eliminated due to the low representation of this group.

Figure 3

QUESTIONS ACCORDING TO EACH CONCEPT VARIABLE:

ASSESSMENT OF OCCUPATIONAL RISK TO HIV: coefficient alpha of .51

6. Le personnel sanitaire a moins de risque de contracter l'infection du VIH que la population en générale. (VRAI OU FAUX)

38. Le personnel sanitaire doit avoir le choix de soigner ou non les malades qui ont le sida. (ÉCHELLE LIKERT) (PAS D'ACCORD)

39. Je cours très peu de risque de contracter le virus du VIH dans mon milieu de travail. (ÉCHELLE LIKERT) (PAS D'ACCORD)

KNOWLEDGE OF TRANSMISSION: coefficient alpha of .57

1. Un enfant né d'une mère séropositive est automatiquement infecté par le virus du VIH. (VRAI OU FAUX)

2. Pour contracter l'infection il faut nécessairement être piqué au moins 3 fois par une aiguille souillée. (VRAI OU FAUX)

9. Il est possible de contracter le virus du VIH par une piqûre de moustique. (VRAI OU FAUX)

14. Une aiguille jetée dans la poubelle ne pose aucun risque de contamination. (VRAI OU FAUX)

21. Nommez les trois modes de transmission. (OUVERT) (3 MODES CITÉS)

22. Combien de relations sexuelles non protégées faut-il pour être exposé à l'infection du VIH? (OUVERT)
(UNE SEULE FOIS)

UNIVERSAL APPLICATION OF PRECAUTIONS: coefficient alpha of .50

4. Les porteurs sains ne peuvent pas transmettre l'infection du VIH car l'infection n'est pas assez avancé. (VRAI OU FAUX)

8. Toute personne qui se présente pour les soins peut être porteur du virus du VIH. (VRAI OU FAUX)

10. Les précautions universelles ne doivent être adoptées que vis-à-vis certains malades. (VRAI OU FAUX)

33. On peut savoir qu'un patient est infecté en le regardant. (ÉCHELLE LIKERT) (Pas d'accord)

PREVENTION OF NEEDLESTICK EXPOSURE: coefficient alpha of .56

15. Il est important de recapuchonner les aiguilles après usage afin d'empêcher une piqûre accidentelle. (VRAI OU FAUX)

25. Nommez 3 façons de se protéger contre les piqûres d'aiguilles? (OUVERT) (NE PAS RECAPUCHONNÉ LES AIGUILLES)

27. Que devez-vous faire avec l'aiguille immédiatement après l'injection? (OUVERT) (METTRE DANS UN RÉCÉPIENT PROTÉGÉ)

Three types of centres were also identified. They include the national hospital and the city hospital. A third category entitled “community centres”, was used to combine the maternal/child health clinic and the community health centre, the two community based health care facilities.

Health care workers were divided into three categories according to their level of training. The first category was comprised of physicians, the second of midwife/nurses and lab technicians, and finally the third was of nurse’s aids and orderlies. Participants fell into the following two work sites: gynaecology/obstetrics, medical/surgical. Using this same strategy, the number of years employed was divided into one to 11 years and 12 to 34 years. Finally, given the high number of participants with no previous training in HIV or AIDS related issues, this variable was divided into those who had not received training versus those who had attended at least one session.

4.6 Data Collection

Data for this study was collected using an auto-administered 42-item questionnaire that was written in French, the working language of Malian health care workers (see annexe 1). Its content was elaborated by the investigator and was based on pertinent literature sources and themes, which were to be discussed in the training inservice. In addition, question items were adapted to suit previous concerns raised during informal interviews with key informants at each of the study sites.

The questionnaire was divided into four sections, measuring: health workers’ general knowledge of the modes of HIV transmission, their knowledge

of universal application of precautions, their knowledge of prevention of needlestick exposure and their perceived susceptibility to HIV exposure. Several different types of formats were used: four point Likert-type scales (with the options strongly agree, agree, moderately agree, strongly disagree), true or false questions, and open-ended questions.

Pre-testing of the questionnaire was limited to eight Malian health care workers who reviewed the questionnaire and made suggestions to improve its comprehension and readability. Given the time constraints, their expertise as health care workers, public health specialists, and educators was used to create the final draft of the questionnaire. Following a brief introduction by the trainers, participants were asked to complete the questionnaire independently. Baseline tests were completed by study participants immediately before the inservice training and promptly collected before session began. Post-intervention testing was done directly after the training was completed, approximately 4 hours after the baseline test. The same questionnaire was administered for both the baseline and post-intervention testing.

4.7 Ethical Considerations

There are many ethical concerns in evaluating issues related to HIV transmission and prevention among health care workers. Some workers may tend to feel threatened by being questioned about their practices especially with regard to HIV (Pichard, E, personal communication, June, 1994). Care was taken to avoid participants' feelings of being «spied on». It was therefore important to ensure that appropriate authoritative channels were followed and

that ample explanations were given to participants. At the beginning of each training session, health care workers were informed that their participation was voluntary and although they were encouraged to remain throughout the entire training session, they were free to leave at any time.

Confidentiality was also stressed during preliminary explanations of each session. Participants were assured that only the investigator had access to completed questionnaires and that only the overall findings would be reported. Each questionnaire would be non-nominally coded sequentially in order to keep their personal identities confidential. The investigator would also shred questionnaires after data analysis was completed.

4.8 Data Analysis

The first step of the analysis explored frequency distributions in order to examine the characteristics of the study population and the variability of their responses for each of the question items. Chi-square tests were later performed to compare the similarity and differences of those participants who completed baseline questionnaires with those who completed both baseline and post-intervention tests. Inter-item correlations between questions of like concept items were also examined and four indices were created. For each of the index variables, a descriptive analysis of each item response was also compiled.

The level of improvement for each of the concept variables was measured by subtracting baseline composite scores from post-intervention test scores. This result yielded a frequency distribution which highlights the number of changed answers found in post-intervention test results compared to the baseline data.

Each of these concepts was subsequently examined in relation to the socio-demographics of the study population with the help of the anova test. Finally, paired t-tests were used to describe the relationship between baseline and post-intervention concept variables.

5 Results

5.1 Characteristics of Study Participants

As outlined in Table 1, a total of 58 health care workers completed both baseline and post-intervention questionnaires. Fifty-six percent of the health care workers who attended the training were over forty years of age. Those with more years of work experience also had a higher participation rate. More nurses, midwives, and lab technicians participated in the study than any other category of worker. The majority of participants worked in medical/surgical areas. Finally, only 37.3 percent of those who attended the entire inservice had received any previous training on HIV (cf. table 1).

Twenty-four participants withdrew from the study. They were present for the baseline test but did not complete the post-test. P-values showed a significant difference between those who participated in the post-test and those who did not except with respect to two socio-demographic characteristics: work site ($p < .01$) and gender ($p < .05$). The city hospital had the lowest participant drop out while the community health centres had the highest. With regards to gender, more males completed both questionnaires than females. Finally, table 2 fails to show any notable differences between the 2 groups in regard to mean knowledge and risk assessment scores.

Table 1
Socio-demographic Variables in Relation to Attendance

	% IN BASELINE n=24	% IN PRE/POST n=58	P-value
Gender			
Male	21.7	48.3	.03
Female	78.3	51.7	
Age			
20-29 years	23.8	18.2	.57
30-39 years	33.3	25.5	
40 + years	42.9	56.4	
Work site			
National Hospital	8.7	29.3	<.01
City Hospital	4.3	39.7	
Community Health Centres	87.0	31.0	
Type of Health Care Worker			
Physician	23.8	16.4	.69
Midwife/Nurse/Lab Tech	66.7	76.4	
Nurse's Aide/Orderly	9.5	7.3	
Department			
OBGYN	25.0	23.1	.93
MED/SURG	75.0	76.9	
Number of Years Employed			
0-11 years	55.0	35.8	.14
12-34 years	45.0	64.2	
Number of Past Training Sessions on HIV			
None	57.1	62.7	.70
At least one	42.9	37.3	

Table 2
Comparison of Baseline Mean Scores
Between Participants who Completed Only the Pretest and
Those Who Completed both Pre and Post Tests
Based on the Number of Correctly Answered Items
for Each Index Variable

Concept Variable	Baseline Mean Pre-test Group n=24	Baseline Mean Pre/post test Group n=58	<i>P-value</i>
ASSESSMENT OF OCCUPATIONAL RISK TO HIV	1,54	1,81	.29
KNOWLEDGE OF HIV TRANSMISSION	3,71	3,69	.96
KNOWLEDGE OF UNIVERSAL APPLICATION OF PRECAUTIONS	2,21	2,26	.86
KNOWLEDGE OF PREVENTION OF NEEDLESTICK EXPOSURE	0,75	1,16	.08

5.2 Effects of Universal Precautions Training Program

5.2.1 Descriptive Analysis of Item Variables

Participants assessed their occupational risk to HIV to be greater than that of the general population more often after the training than they did before (cf. table 3). Three quarters of health care workers who were questioned believed they should not be offered the choice of whether or not to care for AIDS patients. Meanwhile, 62 percent of post-test participants disagree that there is little risk of contracting HIV in their workplace.

Knowledge about the modes of HIV transmission is summarised in table 4. Overall knowledge scores among participants improved after training. The greatest improvement pertained to health care workers' ability to cite three modes of HIV transmission. Only 25.9 percent of participants were able to correctly answer this item during the pre-intervention test. Baseline knowledge of vertical transmission was also limited while post-test scores

Table 3

**FREQUENCY DISTRIBUTION OF ITEM VARIABLES
FOR CONCEPT: ASSESSMENT OF OCCUPATIONAL RISK TO HIV**

n=58

<i>QUESTION ITEM</i>	<i>PERCENT OF CORRECT RESPONSES</i>		<i>PERCENT OF CHANGE</i>
	<i>BASELINE</i>	<i>POST</i>	
6. Le personnel sanitaire a moins de risque de contracter l'infection du VIH que la population en générale. (VRAI OU FAUX)	50.0	70.7	20.7
38. Le personnel sanitaire doit avoir le choix de soigner ou non les malades qui ont le sida. (ÉCHELLE LIKERT) (PAS D'ACCORD)	75.9	77.6	1.7
39. Je cours très peu de risque de contracter le virus du VIH dans mon milieu de travail. (ÉCHELLE LIKERT) (PAS D'ACCORD)	55.2	62.1	6.9

Table 4

**FREQUENCY DISTRIBUTION OF ITEM VARIABLES
FOR CONCEPT: KNOWLEDGE OF HIV TRANSMISSION**

n=58

<i>QUESTION ITEM</i>	<i>PERCENT OF CORRECT RESPONSES</i>		<i>PERCENT OF CHANGE</i>
	<i>BASELINE</i>	<i>POST</i>	
1. Un enfant né d'une mère séropositive est automatiquement infecté par le virus du VIH. (VRAI OU FAUX)	36.2	63.8	27.6
2. Pour contracter l'infection il faut nécessairement être piqué au moins 3 fois par une aiguille souillée. (VRAI OU FAUX)	67.2	74.1	6.9
9. Il est possible de contracter le virus du VIH par une piqûre de moustique. (VRAI OU FAUX)	89.7	96.6	6.9
14. Une aiguille jetée dans la poubelle ne pose aucun risque de contamination. (VRAI OU FAUX)	77.6	75.9	-1.7
21. Nommez les trois modes de transmission. (OUVERT) (3 MODES CITÉS)	25.9	55.2	29.3
22. Combien de relations sexuelles non protégées faut-il pour être exposé à l'infection du VIH? (OUVERT) (UNE SEULE FOIS)	72.4	93.1	20.7

showed a gain of 27.6 percent. Questions on needlestick transmission showed minimal change and one item regarding needle disposal showed a decrease in knowledge after training. Finally, only 3.4 percent of all health care workers who completed post-test questionnaires believed that HIV could be transmitted by a mosquito versus 10.3 percent in baseline responses. There was a wide range of change among item variables starting at -1.7 percent and reaching 29.3 percent.

Knowledge of universal application of precautions improved for each item variable of this construct (cf. table 5). The majority of participants seemed to understand that it is difficult to ascertain if a patient is infected with HIV by simple observation and that universal precautions should be practised with everyone. One item, however, contradicts this trend. In baseline findings, only 31 percent of health care workers questioned acknowledged that any individual under their care could be infected with HIV. Post-test scores did observe an increase of 13.8 percent, yet, the percentage of overall responses remains low in comparison to the high levels of knowledge for the other question items. The level of change for this concept area remains somewhat consistent, between 13.8 and 20.7 percent.

Knowledge of prevention of needlestick exposure represents the most significant level of improvement among all concept areas, ranging from 17.3 percent to 44.9 percent (cf. table 6). Previous to the training intervention,

Table 5
FREQUENCY DISTRIBUTION OF ITEM VARIABLES
FOR CONCEPT: UNIVERSAL APPLICATION OF PRECAUTIONS

n=58

<i>QUESTION ITEM</i>	<i>PERCENT OF CORRECT RESPONSES</i>		<i>PERCENT OF CHANGE</i>
	<i>BASELINE</i>	<i>POST</i>	
4. Les porteurs sains ne peuvent pas transmettre l'infection du VIH car l'infection n'est pas assez avancé. (VRAI OU FAUX)	69.0	82.8	13.8
8. Toute personne qui se présente pour les soins peut être porteur du virus du VIH. (VRAI OU FAUX)	31.0	44.8	13.8
10. Les précautions universelles ne doivent être adoptées que vis-à-vis certains malades. (VRAI OU FAUX)	62.1	84.5	22.4
33. On peut savoir qu'un patient est infecté en le regardant. (ÉCHELLE LIKERT) (Pas d'accord)	63.8	84.5	20.7

Table 6
FREQUENCY DISTRIBUTION OF ITEM VARIABLES
FOR CONCEPT: PREVENTION OF NEEDLESTICK EXPOSURE

n=58

<i>QUESTION ITEM</i>	<i>PERCENT OF CORRECT RESPONSES</i>		<i>PERCENT OF CHANGE</i>
	<i>BASELINE</i>	<i>POST</i>	
15. Il est important de recapuchonner les aiguilles après usage afin d'empêcher une piqûre accidentelle. (VRAI OU FAUX)	17.2	56.9	39.7
25. Nommez 3 façons de se protéger contre les piqûres d'aiguilles? (OUVERT) (NE PAS RECAPUCHONNER LES AIGUILLES)	60.3	77.6	17.3
27. Que devez-vous faire avec l'aiguille immédiatement après l'injection? (OUVERT) (METTRE DANS UN RÉCÉPIENT PROTÉGÉ)	37.9	82.8	44.9

17.2 percent of health care workers did not know the importance of not recapping needles after use. Meanwhile, post-test results show an increase to 56.9 percent. At last, the greatest change was noted in needle disposal practices in which 44.9 percent of participants scored better than they had on baseline questionnaires.

5.2.2 Descriptive Analysis of Concept Variables

Each concept variable is further examined by calculating the number of answer items that demonstrate the level of participant improvement in post-test results (cf. table 7). In all three knowledge areas, there is a consistent pattern of improvement. However, in the area of assessment of occupational risk, this progress is not matched. With regards to prevention of needlestick exposure, 62 percent of participants showed improvement in one to three of their responses. Similarly, knowledge of the modes of transmission and knowledge of universal application of precautions observed gains of 60.3 percent and 56.9 percent respectively.

Some participants also changed their correct item responses to wrong ones while a percentage of those questioned showed no improvement at all. Again, assessment of occupational risk had the least amount of change with 56.9% showing no improvement while knowledge levels showed overall greater improvement. Furthermore, most of this progress is seen in the gain of one or two of the correct response items.

Table 7

**PERCENTAGE OF PARTICIPANTS ACCORDING TO THE NUMBER OF ITEMS
FOR WHICH AN IMPROVEMENT IS OBSERVED
FOR EACH SCALE**

n=58

Concept Variable	% of Participants							
	Deterioration or No Improvement			Improvement				Total Improvement
	-2	-1	0	1	2	3	4	
ASSESSMENT OF OCCUPATIONAL RISK TO HIV	3.4	6.9	56.9	22.4	10.3	--	--	32.7
KNOWLEDGE OF HIV TRANSMISSION	--	1.7	37.9	32.8	24.1	3.4	--	60.3
KNOWLEDGE OF UNIVERSAL APPLICATION OF PRECAUTIONS	--	6.9	36.2	39.7	15.5	--	1.7	56.9
KNOWLEDGE OF PREVENTION OF NEEDLESTICK EXPOSURE	--	12.1	25.9	24.1	24.1	13.8	--	62.0

Note: "-2, -1, 0, 1, 2, 3, 4" indicate the number of answer items in which there was an observed change in responses.

5.2.3 Concept Variables According to Socio-Demographics

This section focuses on the socio-demographic characteristics of study participants which may contribute to the adoption of universal precautions practice. Tables 8 through 11 display mean changes for each scale as well as the F-scores obtained for each of the socio-demographic categories. Three significant findings were discovered during this step of the analysis. All other p-values were greater than .05.

Analysis of the index variable, assessment of occupational risk, found that for age and number of years employed p-values were .06 and .08 respectively (cf. Table 8). Health care workers who were over 40, exhibited the greatest change while those under 29 years actually changed their correct responses in the post-test questionnaire to incorrect answers. Likewise, with regards to the number of years employed, participants who worked 12 to 34 years had an improved mean response of .47. On the other hand, those with fewer years had .05. In reference to the differences in performance among health care workers, physicians also had higher baseline scores but actually showed a decrease in their scores on the post-test, although this was not statistically significant. All other categories produced mean scores ranging from .36 to .50.

Mean levels of improvement regarding participants' knowledge of HIV transmission remained relatively consistent, regardless of their socio-demographic characteristics (cf. Table 9). All categories of respondents showed a mean change of the number of responses ranging from .67 to 1.10.

Table 8
Mean Changes for the Assessment of Occupational Risk Scale
by Selected Socio-demographic Variables

n=58

	<i>Mean Base- line</i>	<i>Mea n Post- test</i>	<i>Mean Change s</i>	<i>SD</i>	<i>P-value</i>
Gender					
Male (n=28)	1.96	2.25	.29	.81	.95
Female (n=30)	1.67	1.97	.30	.95	
Age					
20-29 years (n=10)	2.60	2.30	-.30	.82	.06
30-39 years (n=14)	1.79	2.07	.28	.91	
40 + years (n=31)	1.68	2.13	.45	.81	
Work site					
National Hospital (n=17)	1.82	2.12	.29	1.10	.42
City Hospital (n=23)	1.96	2.09	.13	.69	
Community Health Centres (n=18)	1.61	2.11	.50	.86	
Type of Health Care Worker					
Physician (n=9)	2.22	2.00	-.22	.67	.17
Midwife/Nurse/Lab Tech (n=42)	1.95	2.31	.36	.90	
Nurse's Aide/Orderly (n=4)	.25	.75	.50	.58	
Department					
OBGYN (n=9)	2.22	2.33	.11	.78	.72
MED/SURG (n= 30)	1.83	2.07	.23	.94	
Number of Years Employed					
0-11 years (n=19)	2.42	2.47	.05	.62	.08
12-34 years (n=34)	1.53	2.00	.47	.90	
Number of Past Training Sessions in HIV					
None (n=32)	1.81	2.19	.38	.87	.41
At least one (n=19)	2.00	2.16	.16	.96	

Note: 0=No change; >0=Improvement; <0=Deterioration

Table 9

**Mean Changes for the Transmission Scale
by Selected Socio-demographic Variables**

n=58

	<i>Mea n Base -line</i>	<i>Mea n Post- test</i>	<i>Mean Change s</i>	<i>SD</i>	<i>P-value</i>
Gender					
Male (n=28)	4.07	4.89	0.82	.90	.55
Female (n= 30)	3.33	4.30	.97	.93	
Age					
20-29 years (n=10)	3.80	4.90	1.10	1.10	.62
30-39 years (n=14)	3.14	4.21	1.07	.92	
40 + years (n=31)	3.90	4.74	.83	.86	
Work site					
National Hospital (n=17)	3.88	4.65	.76	.75	.64
City Hospital (n=23)	4.00	4.87	.87	.92	
Community Health Centres (n=18)	3.11	4.17	1.06	1.06	
Type of Health Care Worker					
Physician (n=9)	4.56	5.56	1.00	.87	.43
Midwife/Nurse/Lab Tech (n=42)	3.69	4.57	.88	.89	
Nurse's Aide/Orderly (n=4)	1.75	3.25	1.50	1.29	
Department					
OB/GYN (n=9)	4.22	4.89	.67	.71	.47
MED/SURG (n=39)	3.80	4.70	.90	.88	
Number of Years Employed					
0-11 years (n=19)	4.00	5.00	1.00	1.00	.66
12-34 years (n=34)	3.50	4.38	.88	.88	
Number of Past Training Sessions in HIV					
None (n=32)	3.66	4.47	.81	.93	.35
At least one (n=19)	3.95	5.00	1.05	.78	

Note: 0=No change; >0=Improvement; <0=Deterioration

There appears to be a statistically significant relationship between the improvement in the knowledge of universal application of precautions and the type of health care worker ($p=.02$) (cf. Table 10). Midwives, nurses, and lab technicians showed more improvement than physicians. Nurse aides and orderlies showed no changes in knowledge levels. Two other categories, department ($p=.14$) and number of years employed ($p=.12$), also showed a potential for a possible relationship in bivariate analysis. Participants working on medical/surgical departments improved four times as much as those working in OBGYN. In addition, health care workers with 12 to 34 years of experience tended to have double the progress than those with lesser experience.

Finally, there are two socio-demographic categories which may play a role in influencing participants' capacity to increase their knowledge of prevention of needlestick exposure (cf. Table 11). These include gender ($p=.02$) and number of years employed ($p=.09$). Results show that males tend to show higher mean gain scores than females, 1.39 compared with .67. Again, there is a twofold increase in results among health care workers with 12 to 34 years of employment versus those with 11 years or less.

Table 10

**Mean Changes for the Universal Application Scale
by Selected Socio-demographic Variables**

n=58

	<i>Mea n Base -line</i>	<i>Mea n Post- test</i>	<i>Mean Change s</i>	<i>SD</i>	<i>P-value</i>
Gender					
Male (n=28)	2.54	3.32	.79	1.10	.54
Female (n=30)	2.00	2.63	.63	.76	
Age					
20-29 years (n=10)	2.30	3.20	.90	.88	.72
30-39 years (n=14)	2.21	2.79	.57	.85	
40 + years (n=31)	2.26	2.97	.71	1.04	
Work site					
National Hospital (n=17)	2.29	2.94	.65	.86	.92
City Hospital (n=23)	2.57	3.26	.70	1.14	
Community Health Centres n=18)	1.83	2.61	.78	.73	
Type of Health Care Worker					
Physician (n=9)	3.56	3.67	.11	.60	.02
Midwife/Nurse/Lab Tech (n=42)	2.10	3.00	.90	.96	
Nurse's Aide/Orderly (n=4)	1.00	1.00	.00	.82	
Department					
OBGYN (n=9)	3.00	3.22	.22	.67	.14
MED/SURG (n=30)	2.27	3.07	.80	1.10	
Number of Years Employed					
0-11 years (n=19)	2.47	2.89	.42	.90	.12
12-34 years (n=34)	2.09	2.94	.85	.99	
Number of Past Training Sessions in HIV					
None (n=32)	2.09	2.84	.75	1.02	.96
At least one (n=19)	2.53	3.26	.74	.93	

Note: 0=No change; >0=Improvement; <0=Deterioration

Table 11

**Mean Changes for the Prevention of Needlestick Exposure Scale
by Selected Socio-demographic Variables**

n=58

	<i>Mea n Base -line</i>	<i>Mea n Post- test</i>	<i>Mean Change s</i>	<i>SD</i>	<i>P-value</i>
Gender					
Male (n=28)	1.07	2.46	1.39	1.10	.02
Female (n=30)	1.23	1.90	.67	1.30	
Age					
20-29 years (n=10)	1.30	2.10	.80	1.40	.46
30-39 years (n=14)	1.29	2.14	.86	1.29	
40 + years (n=31)	1.03	2.29	1.26	1.18	
Work site					
National Hospital (n=17)	1.47	2.29	.82	1.42	.27
City Hospital (n=23)	.96	2.30	1.35	1.07	
Community Health Centres n=18)	1.11	1.89	.78	1.26	
Type of Health Care Worker					
Physician (n=9)	1.22	2.11	.89	1.05	.54
Midwife/Nurse/Lab Tech (n=42)	1.14	2.31	1.17	1.29	
Nurse's Aide/Orderly (n=4)	1.00	1.50	.50	1.29	
Department					
OBGYN (n=9)	1.33	2.33	1.00	1.73	.73
MED/SURG (n=30)	1.13	2.30	1.17	1.12	
Number of Years Employed					
0-11 years (n=19)	1.42	2.11	.68	1.11	.09
12-34 years (n=34)	1.00	2.29	1.29	1.29	
Number of Past Training Sessions in HIV					
None (n=32)	1.00	2.19	1.19	1.28	.42
At least one (n=19)	1.37	2.26	.89	1.15	

Note: 0=No change; >0=Improvement; <0=Deterioration

5.2.4 Paired t-tests between Pre and Post Test Concept Variables

Paired t-test results were significant in the analysis of all concept variables, thus confirming that participants had an overall better response rate in the post-intervention test than in the baseline (cf. Table 12). P-values for knowledge of the modes of HIV transmission, knowledge of universal application of precautions, and knowledge of prevention of needlestick exposure equalled to $< .01$. For the concept of assessment of occupational risk, the p-value was $p < .05$.

5.2.5 Additional Findings Related to Universal Precautions

Results presented in table 13 represent descriptive question items that do not belong to any specific index, but may offer additional insight into the practice of universal precautions. In question 34, participants seem to acknowledge concerns regarding the financial burden of universal precautions. These concerns appear to decrease after training from 63.8 to 56.9 percent. Approximately half of the respondents in both baseline and post-intervention test results find that universal precaution techniques require too much time (see question 35).

When participants were asked if they had sufficient knowledge to protect themselves against HIV, about a quarter of them thought they did, even after training (see question 40). Question 18 shows that 51.7 percent of those questioned said that they systematically practise universal precautions. Post-test scores actually rose to 62.1 percent even though questionnaires were completed immediately after the inservice. Eleven percent of health care workers either did

Table 12

Paired t-tests between Baseline and Post-Intervention Test Scales

n=58

<i>Variable</i>	<i>Mean Baseline</i>	<i>Mean Post-test</i>	<i>P-value</i>
KNOWLEDGE OF HIV TRANSMISSION	3.68	4.58	p < .01
KNOWLEDGE OF UNIVERSAL APPLICATION OF PRECAUTIONS	2.25	2.96	p < .01
KNOWLEDGE OF PREVENTION OF NEEDLESTICK EXPOSURE	1.16	2.17	p < .01
ASSESSMENT OF OCCUPATIONAL RISK TO HIV	1.81	2.10	p < .05

not realise they were practising universal precautions correctly or they may have been unfamiliar with the terminology. The issue of social desirability can also be raised as a possible explanation for the observed increase in these scores.

Finally, the greatest change is seen in question 37, with 94.8 percent of health care workers who attended the educational inservice acknowledging the effectiveness of universal precautions, compared to initial baseline scores of 17.2 percent.

Table 13
FREQUENCY DISTRIBUTION OF ADDITIONAL QUESTION ITEMS

n=58

<i>QUESTION ITEM</i>	<i>PERCENTAGE OF RESPONSES</i>	
	<i>BASE-LINE</i>	<i>POST-TEST</i>
34. Maintenir les précautions universelles dans les milieux de soins est un fardeau financier. (<i>D'ACCORD</i>)	63.8	56.9
35. Les techniques de précautions universelles consomment trop de temps. (<i>PAS D'ACCORD</i>)	51.7	51.7
40. J'ai suffisamment de connaissances pour me protéger contre l'infection par le VIH. (<i>D'ACCORD</i>)	29.3	25.9
18. Appliquez-vous toutes les précautions de manière systématique? (<i>OUI</i>)	51.7	62.1
37. Les précautions universelles sont efficaces pour contrôler la transmission du VIH dans les milieux de soins. (<i>D'ACCORD</i>)	17.2	94.8

6 Discussion

Many (Horsman & Sheeran, 1995; Levin, 1995) have criticised researchers for submitting findings that lack sound theoretical and methodological support. The strength of this work lies in the description of the challenges associated with measuring concepts related to HIV and infection control among health care workers, particularly in a context such as Mali. Since there is little documented knowledge on the methodological pitfalls in researching universal precautions that are common to many developing countries, these criticisms may contribute to the development of a wider knowledge base in this area.

The discussion of this study is therefore developed from the point of view of its weaknesses. It focuses on the study's choice of methodology, which consequently, has limited the interpretation of reported findings. Although data analysis has failed to yield many statistically significant results, the study hypotheses brought forth in this work cannot be completely discarded. Certain patterns do seem to have emerged from the data and offer direction for further research opportunities.

Despite the expansion of the HIV/AIDS epidemic in sub-Saharan Africa, 49% of study participants had received no previous training in HIV. Furthermore, less than a third found they had sufficient knowledge to protect themselves from occupational exposure to HIV. These responses help build a very convincing argument for developing and implementing sustainable educational efforts that are specifically designed for health care workers. This work further reinforces the

immediate need for developing appropriate tools to implement such programs as well as to evaluate their effect, both at the individual and organisational levels.

6.1 Effects of the Intervention

The following section examines the effects of the universal precautions educational inservice on each of the concept variables in relation to the hypotheses brought forth in chapter three. In addition, the role of socio-demographic variables is raised. Finally, issues regarding possible barriers to universal precautions practice among study participants are briefly discussed.

6.1.1 Effects on Participants' Assessment of Occupational Risk in the Health Care Setting

Among all concept variables that were studied, findings regarding participants' ability to accurately assess their risk for HIV exposure yielded the least improvement. In addition, 45 percent of those questioned did not find themselves to be at risk for HIV exposure in their workplace. These figures also remained relatively unchanged after the inservice intervention. Given that many health care workers underestimate self-reported risk, an observational study of their practice would be useful to ascertain whether this assessment is actually correct.

Although almost half of those health care workers questioned did not link any exposure risk to HIV to their occupation, many did perceive their level of risk to be higher than that of the general population. In addition, post-test scores indicated that participants' assessment of their risk in the health care setting increased when comparing themselves to the general population. Are health

care workers, then, truly more at risk for HIV than the general population? Studies (Hammond et al., 1990; Henry et al., 1994; Henry et al., 1992; Hersey & Martin, 1994; Keith & Campbell, 1992; Kelen, 1990; Lyons et al., 1992; Ronk & Girard, 1994), including one in Mali (Bouvet et al., 1991), have documented frequent needlestick injury among health care workers, and clearly point to this conclusion. Yet, many participants in this study continue to appraise themselves as being at low risk for HIV exposure. These conflicting viewpoints reflect similar discrepancies observed in the literature.

As previously discussed in the literature review, it is difficult to distinguish health care workers' personal risk from their occupational risk. Identifying the source of HIV infection among health care workers in developing countries is even more difficult where there is little, if any, follow-up of occupational exposure. Until occupational risks are more accurately assessed, there will remain certain confusion with regards to the extent of HIV transmission in the health care setting. Regardless of the actual risk, there are real concerns about the impact on the work force of a perceived increase in risk given the trends in other countries which show a decreased retention of qualified health personnel in proportion to increases in the numbers of hospitalised AIDS patients.

6.1.2 Effects on Participants' Knowledge of HIV Transmission

There are significant improvements in participant post-intervention test scores within each of the knowledge areas. Health care workers appeared to have the most difficulty with questions concerning mother-to child transmission and the main modes of transmission. It is equally interesting to note that

baseline results show that some health care workers still believed that HIV could be transmitted by a mosquito bite. Although most participants improved in their post-test responses, a few remained unconvinced. It is thus important to understand and incorporate popular knowledge in education programs, including those that are geared toward health care workers.

This is especially important in light of one study, which showed that the majority of health care workers received much of their knowledge of the modes of HIV transmission from television, radio and other mass media campaigns (Li et al., 1992). What is the effect then of training programs which rely on peer education to disseminate information to their colleagues? Is the role of health care workers in the fight against HIV and AIDS sufficiently utilised within both the health care setting and the general community? Few published studies explore these questions. Meanwhile, in a culture where the power of oral tradition is unequalled, this is an important opportunity for preventing the spread of HIV infection.

6.1.3 Effects on Participants' Knowledge of Universal Application of Precautions

Post-training results showed a strong and consistent improvement with percentages reaching well into the eighties for each of the concept items. There was however, an exception with one item variable. Although respondents answered correctly to all the other items of this construct, only 45 percent considered that all patients presenting for care are potentially infected with HIV. It is not clear why this response differs so greatly from the others. It may be

related to the inherent flaws of the questionnaire. These shortcomings are raised in section 6.2.

6.1.4 Effects on Participants' Knowledge of Prevention of Needlestick Exposure

Since needlestick injury is the greatest source of occupational exposure to bloodborne pathogens, it is encouraging to point out that post-test questionnaire findings showed the largest progress in the area of knowledge of needlestick exposure prevention. Despite these improvements, 43 percent of participants still do not know that recapping needles increases accidental needlestick injury. This aspect of any educational program would need to be given greater attention especially since most facilities do not have specifically designed sharps disposal containers to decrease exposure to used injection equipment. In addition, further understanding of this issue is required to examine the difference which may exist between knowing that recapping needles increases accidental needlestick injury and still having to do this because needles need to be reused due to financial constraints.

The relatively low percentage of responses could also reflect certain practices such as the reuse of needles and syringes. For instance, glass syringes are still used in some health centres for immunisation clinics. Other health care workers also recycle syringes for their own private use. In either case, needlestick prevention strategies may appear completely impractical to health care workers and may reflect discordance with their existing ways of thinking and behaving. Modifying health care workers' practices may be

beneficial in decreasing HIV transmission via used needles and syringes, but consideration must also be given to the implications such change would demand. Failure to address these concerns would undermine attempts in implementing infection control strategies that are congruent with the individual and environmental concerns of Malian health care workers.

6.2 Relationship between Socio-demographics and Level of Improvement

Participants' socio-demographic characteristics do not appear to influence the level of improvement among health care workers' post-intervention test results. All p-values fail to show any significant relationships between the four concept variables and respondents' gender, age, type of facility, position, department, years of experience, and number of previous HIV training sessions. These results are encouraging since they lend support to Alleder's (1991) findings which report homogeneous improvement among participants' post-test scores, regardless of their socio-demographic heterogeneity. Indeed, the participation of a broad-spectrum audience may provide attractive benefits in exchanging knowledge at many levels of the organisation. As Boivin (Boivin, 1994) has highlighted, participants from different disciplines can share their respective knowledge and perspectives with other group members, creating a complimentary systems approach to learning.

Some socio-demographic variables cannot be completely ignored despite a lack of significant associations with outcome variables. With regards to the assessment of occupational risk, data analysis reveals that older and more

experienced participants showed greater improvement than their younger colleagues did. This is understandable since younger health care workers have access to recent knowledge and therefore have higher baseline scores. Consequently, they also show less improvement. Furthermore, the knowledge base of older health care workers may have become outdated or possibly forgotten, and thus they may have more to gain from an educational inservice.

Likewise, knowledge of the principle of universality showed the greatest progress among older participants. In addition, midwives, nurses, and lab technicians demonstrated the highest improvement among all types of health care workers. Although these groups of health care workers are more involved in the physical care of patients, it is possible that they had never been exposed to these concepts before. As a result, this group of health care workers had lower baseline scores and therefore had more room for improvement in their mean change scores.

It is also interesting to note that post-intervention test scores for this concept variable were four times higher in the medical/surgical departments. With respect to improvements in participants' knowledge of prevention of needlestick exposure, results show that, again, those with more years of work experience benefited the greatest. Finally, gender also appears to influence this variable with men having increased their knowledge levels by double.

In general, these results suggest that those most affected by HIV transmission in the workplace also appear to have gained the most from the education inservice. It also highlights the importance of offering continuing

education to older and more experienced health care workers, who may never have received training on universal precautions. This is vital since they often play a mentorship role in the practical training of health care students. In addition, care should be taken to include frontline workers involved in direct patient care, such as midwives, nurses, and lab technicians, in any future training programs.

6.3 Potential Impediments to Participants' Practice of Universal Precautions

Many health care workers still view the implementation of universal precautions in their workplace as too costly and too time consuming. In addition, only 26 percent of participants felt they had sufficient knowledge to protect themselves against HIV infection. If institutional infection control policies are to include universal precautions, these concerns need to be addressed. Adaptable technologies for facilitating the implementation of universal precautions should also be site-specific. Post-intervention scores citing financial barriers actually decreased by seven percent, suggesting that some health care workers may have begun to realise that universal precautions practice is not solely dependent on financial constraints.

The most notable finding in this study is that three quarters of participants increased their awareness that the practice of universal precautions helps control the risk for HIV transmission in the health care setting (cf. Table 12, Question 37). This seems to indicate that many health care workers, especially those professionals involved in direct patient care and support, have not been exposed

to current information on infection control and have the most to gain from education interventions.

6.4 Strengths and Limitations of the Study

Methodological weaknesses make it difficult to establish whether the intervention influenced the results discussed in the previous section. As with other work, the inadequacies of research methods that have been used in the study of health care workers and HIV remain a pervasive problem. Many researchers in developed countries have already reviewed the criticisms of the current body of literature (Horsman & Sheeran, 1995; Levin, 1995). The following discussion highlights the methodological challenges from the viewpoint of a developing country.

6.4.1 Weaknesses Related to the Study Design

The development and pilot testing of the educational package in universal precautions training for Malian health care workers was not based on any specific theoretical framework. It was based on the practical field work experience of the researcher and actors participating in the video. As such, the study was not useful in evaluating the specific effects of the educational package. Given weaknesses associated with the study design, the evaluation of this education program failed in its ability to link the results with the intervention. With regard to the choice of educational strategies, study results obtained could not provide any evidence that the use of these specific educational tools and methods were the source of the observed improvement among health care workers. Indeed, the absence of a solid theoretical framework could explain the lack of study findings.

The use of a non-experimental design made it difficult to control for potential extraneous influences, challenging any valid claim as to effectiveness of the intervention. The most important threats to the internal validity of the study include testing, history, and maturation biases.

The influence of testing occurs when the process of taking a test improves participant scores. Some health care workers may have had difficulty reading French. Although it is their working language, it is not their mother tongue. Taking the test a second time could have facilitated their comprehension of the questionnaire, and consequently, increased their scores. In order to minimise testing bias, all questionnaires were gathered immediately after the baseline test, thus ensuring that participants did not have access to their previous answers while they completed the post-intervention test.

History bias has also been noted to be a potential threat in the one-group pre-test/post-test design. This happens when events occur during the time lapse between the two measurements, and as a result, could account for any change observed in the second measurement. However, since the baseline tests and post-intervention tests were completed immediately before and after the training session was completed, it is likely to have had only a slight influence on participant responses. Another advantage in giving the two tests so closely together is that it minimised participant discussion of question items.

An experimental design using a control group in which participants responded to both baseline and post-test questionnaires without the intervention would have more accurately measured the effects of the training while controlling

for biases related to internal validity. Experimental designs would also be useful in further evaluating the effects of the educational package.

It may have been interesting to pursue additional testing and measure the long-term effects of the intervention in a time-series design. However, at the time the study was undertaken, there was insufficient time and financial resources to be able to plan this type of research. Although this approach could provide additional insight into the effects of the intervention over time, it also increases the potential for biases that have been previously outlined. Furthermore, given that the measurement tool has proved to be inadequate in determining the effectiveness of the intervention, it is likely wiser to exploit the lessons learned in this study and look toward future research opportunities.

The pre-test/post-test design used in this study could not evaluate whether the teaching strategies were culturally appropriate. While it is important to consider the cultural fabric in developing strategies to promote a desired behaviour or outcome, Schoepf (Schoepf, 1991) points out that these influences should not be used as a crutch to justify inertia. Since workers around the world appear to struggle at some level with the practice of universal precautions, researchers must be wary in targeting only cultural differences as explanations for behaviours.

Finally, quantitative data may be useful in describing the prevalence of certain concepts or behaviours of Malian health care workers, yet the understanding of universal precautions use remains limited. Qualitative designs (Scott & Mercer, 1994) may uncover why health care workers fail to adopt

universal precautions and how the “individual’s beliefs and actions are interwoven with collective norms and structures “ (p. 83).

6.4.2 Self-Selection Bias

Given that participants were not randomly selected to participate in the intervention, there is a strong possibility of a selection bias which would affect the generalisability of the findings. In view of the absence of a control group, there is no way of knowing if the health care workers who participated in the intervention were representative of the knowledge level of their group. If those with little knowledge only participated, the results would be an overestimation of the improvement had all health care workers attended. If those with greater knowledge opted not to attend the education session then the observed changes after the intervention would be an underestimation. Some of the bias was minimised somewhat, however, since participants were selected by their supervisors based on staff availability.

6.4.3 Sample Size

Another problem lies in the sample size. The high attrition rate combined with the low number of participants leads to a low statistical power. One reason for low participation levels is the cost of implementing the training sessions. In addition, the education strategy sought to promote group learning environments with a maximum of 25 participants in each session, thus limiting the possibility of participation of all eligible health care workers. Finally, the scheduling of the inservices may need to be revisited since some health care workers were called away during the training to care for patients. On the other hand, it is quite

possible that any systematic and continuous training of health care workers in developing countries will take this format and include any biases associated with it.

6.4.4 Lack of Measurement Precision

The questionnaire used in this study has not been tested for its validity and reliability. Although a group of Malian resource persons had commented on the questionnaire, there remain fundamental flaws in its structure and wording. Its length serves only to contribute to its unfriendliness. The mixture of open ended, true or false, and Likert scales add further confusion. Even the Likert scales failed to capture the full range of choices required by the participants. A more wider consultation process concerning the use of this questionnaire would have been beneficial.

The questions themselves lack clarity. Some have multiple interpretations. Others are negatively worded and leading. As previously discussed, French is the working language of Malian health care workers, but not necessarily the most accessible language for all participants. It is not clear what the degree of comprehension was among health care workers who completed the questionnaires. This factor may have also influenced attendance at the education program as well as participant response to the questionnaire items.

Finally, many questions were asked using personal "I" wording, pressuring the respondent to take a position and perhaps encouraging more socially acceptable answers. It is thus very likely that there is a high self-reporting bias. Issues regarding HIV and AIDS have a cultural significance (Schoepf, 1991),

which could influence participants' willingness to accurately respond to some of the questions. Focus group discussions to assess the extent of such influences would have been beneficial in constructing the questionnaire. Formal pre-testing of the questionnaire would also have helped to reduce many of these flaws.

These obstacles also had a great impact on the development of the concept variable scales. Their reliability coefficients ranged only between .50 and .57. Again, this instrument lacked pre-testing for its reliability, making it difficult to claim that the question items accurately measure their respective concept variables.

6.5 Implications for Future Research

This study identifies knowledge needs among Malian health care workers who participated in this study. A more detailed needs assessment of Malian health care workers could be performed to better tailor future training programs. Greater theory development which focuses on clarifying the roles of knowledge of universality and risk assessment would be a definite asset in designing the content of such education programs.

There does appear to be some benefits in including all levels of health care workers in the same education session. This type of learning environment could be further studied. It would be equally interesting to examine the extent to which the teaching methods were influential in improving health care workers' level of knowledge. At the same time, these interventions would provide an opportunity for additional health care workers to participate in continuing

education activities, thus offering greater access to current information while promoting some continuity of these initial efforts.

Prevention of needlestick exposure appears to be a vital concept for future exploration. Adaptable technology, such as placing used syringes and needles in used IV glass bottles, would be an important step in improving health care workers adherence to universal precautions. However, further examination of health care workers' rationales for not systematically using these precautions already would be a pre-requisite.

Evaluations of this program's implementation would also likely reveal that the administration was not fully included in the process. Further strategies could be explored to increase health care worker participation in the program. Indeed, a more detailed political and organisational analysis would need to be completed in order to strengthen institutional and employee commitment to universal precautions. This would include an evaluation of the impact of wage reduction policies that have targeted health care workers and have encouraged the growth of the "under the table" health care services. Finally, greater time and attention should be placed on designing measurement tools and theoretical models that would more accurately reflect the context of Malian health care workers.

7. Conclusion

In spite of all its methodological flaws, this exploratory study raises several issues regarding infection control knowledge, education, and evaluation in developing countries. It brings to the forefront the plight of health care workers working in a world with HIV and AIDS. In the end, the methodological and

theoretical challenges are quite comparable in all parts of the world. The difference lies mainly in the levels of financial resources available to address the issues raised. In countries where malnutrition, malaria, and diarrheal disease remain national priorities, the place of universal precautions training may be disputed. However, for health care workers on the frontlines of the HIV epidemic, universal precautions practice offers the best known protection against the spread of HIV in the health care setting.

Health care workers, can at once be potential vectors and victims of HIV. They play a vital role in helping to minimise the risk of HIV transmission in the health care setting and in educating their clients in HIV prevention. It is thus essential that they receive continuing education that is current and relevant to their needs.

This study aimed to measure the effects of an education program geared towards Malian health care workers. It was done in less than ideal conditions with inadequacies in both study design and instrumentation. Nonetheless, results have pointed towards potential trends that illuminate the road for future research studies.

As the HIV epidemic expands, the susceptibility for other infectious diseases among health workers and the general population will rise. This in turn will impact on capacity of health facilities to adequately respond to the growing needs of their patients. Infection control policies promoting universal precautions may be part of the solution in minimising exposure to bloodborne pathogens such as HIV among health workers and the general population.

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Annexe 1
Questionnaire

LA LUTTE CONTRE LE SIDA DANS LES MILIEUX DE SOINS

OUTIL D'ÉVALUATION

NOM: _____

CENTRE: _____

Les questions 1 à 15 sont des questions d'ordre général sur l'infection VIH. Répondez par "vrai", "faux" ou "ne sais pas". Encerclez votre réponse.

Questions	VRAI	FAUX	NE SAIT PAS
1. Un enfant né d'une mère séropositive est automatiquement infecté par le virus du VIH.	V	F	?
2. Pour contracter l'infection il faut nécessairement être piqué au moins 3 fois par une aiguille souillée.	V	F	?
3. Une personne qui reçoit une seule unité de sang contaminé par le virus a 50 % de risque de contracter l'infection.	V	F	?
4. Les porteurs sains ne peuvent pas transmettre l'infection du VIH car l'infection n'est pas assez avancée.	V	F	?
5. Il est nécessaire de faire le test de dépistage après toute piqûre accidentelle.	V	F	?
6. Le personnel sanitaire a moins de risque de contracter l'infection du VIH que la population en générale.	V	F	?
7. La méthode de dépistage ELISA assure à 100% la détection des anticorps du virus dans le sang.	V	F	?
8. Toute personne qui se présente pour les soins peut être porteur du virus du VIH.	V	F	?
9. Il est possible de contracter le virus du VIH par une piqûre de moustique.	V	F	?
10. Les précautions universelles ne doivent être adoptées que vis-à-vis certains malades.	V	F	?

- | | | | |
|--|---|---|---|
| 11. Les seringues à usage unique peuvent être réutilisées si elles sont correctement stérilisées. | V | F | ? |
| 12. Il est recommandé de porter des gants lors de tout contact avec le sang ou des produits sanguins. | V | F | ? |
| 13. L'eau de javel tue le virus du VIH. | V | F | ? |
| 14. Une aiguille jetée dans la poubelle ne pose aucun risque de contamination. | V | F | ? |
| 15. Il est important de recapuchonner les aiguilles après usage afin d'empêcher une piqure accidentelle. | V | F | ? |

Pour les questions suivantes, donnez votre opinion concernant le risque de transmission dans les milieux de soins. Encerclez la réponse qui correspond le plus à ce que vous pensez.

- | | | | |
|--|-----|-----|-------------------|
| 16. Pensez-vous qu'une personne peut attraper e virus en donnant du sang? | OUI | NON | NE
SAIS
PAS |
| 17. Est-ce qu'un malade peut infecter un membre du personnel sanitaire? | OUI | NON | NE
SAIS
PAS |
| 18. Appliquez-vous toutes les précautions de manière systématique? | OUI | NON | NE
SAIS
PAS |
| 19. Pensez-vous qu'un malade du sida peut transmettre l'infection à une autre malade non-infecté par l'intermédiaire du personnel sanitaire? | OUI | NON | NE
SAIS
PAS |
| 20. Accepteriez-vous de passer un test de dépistage pour le VIH? | OUI | NON | NE
SAIS
PAS |

Les questions suivantes portent sur la transmission de l'infection du VIH et les précautions universelles. Écrivez votre réponse dans l'espace désigné.

21. Nommez les 3 modes de transmission du VIH.

22. Combien de relations sexuelles non protégées faut-il pour être exposé à l'infection du VIH?

23. Dans quelles circonstances est-ce que vous devez porter les gants?

24. A quoi sert de porter les gants?

25. Nommez 3 façons de se protéger contre les piqûres d'aiguilles.

26. Quelle est la procédure à suivre si vous vous faites piquer par une aiguille souillée?

27. Que devez-vous faire avec l'aiguille immédiatement après l'injection?

28. Nommez 3 façons d'éliminer les ordures.

29. Nommez 3 pratiques dangereuses dans les milieux de soins qui peuvent potentiellement transmettre le virus du VIH à un patient.

30. Lesquelles de vos patients devront être considérés potentiellement infectieux?

31. Nommez le fluide corporel qui est le plus associé à la transmission de l'infection par le VIH (une seule réponse).

Pour la section suivante, veuillez encercler la réponse qui correspond le plus à votre opinion.

32. Le personnel sanitaire court un risque plus élevé de contracter le virus du VIH que la population générale.

**Tout à fait
d'accord**

D'accord

**Moyennement
d'accord**

**Pas du tout
d'accord**

33. On peut savoir qu'un patient est infecté en le regardant.

**Tout à fait
d'accord**

D'accord

**Moyennement
d'accord**

**Pas du tout
d'accord**

34. Maintenir les précautions universelles dans les milieux de soins est un fardeau financier pour les structures sanitaires.

**Tout à fait
d'accord**

D'accord

**Moyennement
d'accord**

**Pas du tout
d'accord**

35. Les techniques de précautions universelles consomment trop de temps.

**Tout à fait
d'accord**

D'accord

**Moyennement
d'accord**

**Pas du tout
d'accord**

36. Si j'avais le choix, je préférerais ne pas soigner les malades qui ont le sida.

Tout à fait d'accord	D'accord	Moyennement d'accord	Pas du tout d'accord
---------------------------------	-----------------	---------------------------------	---------------------------------

37. Les précautions universelles sont efficaces pour contrôler la transmission du VIH dans les milieux des soins.

Tout à fait d'accord	D'accord	Moyennement d'accord	Pas du tout d'accord
---------------------------------	-----------------	---------------------------------	---------------------------------

38. Le personnel sanitaire doit avoir le choix de soigner ou non les malades qui ont le sida.

Tout à fait d'accord	D'accord	Moyennement d'accord	Pas du tout d'accord
---------------------------------	-----------------	---------------------------------	---------------------------------

39. Je cours très peu de risque de contracter le virus du VIH dans mon milieu de travail.

Tout à fait d'accord	D'accord	Moyennement d'accord	Pas du tout d'accord
---------------------------------	-----------------	---------------------------------	---------------------------------

40. J'ai suffisamment de connaissances pour me protéger contre l'infection par le VIH.

Tout à fait d'accord	D'accord	Moyennement d'accord	Pas du tout d'accord
---------------------------------	-----------------	---------------------------------	---------------------------------

41. Il est difficile de pratiquer les précautions universelles dans mon milieu de travail.

Tout à fait d'accord	D'accord	Moyennement d'accord	Pas du tout d'accord
---------------------------------	-----------------	---------------------------------	---------------------------------

Expliquez: _____

42. Avez-vous peur de contracter le sida?

OUI

NON

(Pré-test seulement)

Pour terminer, nous avons besoin de quelques informations pour nous aider dans l'analyse des données.

Combien de fois avez-vous suivi un programme de formation sur la transmission du VIH dans les milieux de soins? _____

Quel est votre fonction? _____

Nombre d'années d'expérience dans votre fonction _____

Quel est le nom de votre service? _____

Quel âge avez-vous? (Encerclez le groupe d'âge)

20 à 29 ans

30 à 39 ans

40 à 49 ans

50 et +

Sexe: **homme** _____

femme _____

Merci de votre collaboration et bonne formation!

