



First, Do No Harm: The Toll of Unhealthy Health Care Practices

By Lorraine Mooney and Roger Bate

The dirty little secret of public health is the disease and death caused by those employed to cure the sick. Hospital-acquired infections¹ (HAIs) are estimated by the World Health Organization (WHO) to kill between 1.5 and 3 million people every year.² Unhygienic practices and unclean hospitals—and, in poorer nations, unsafe blood products and reused injection equipment—kill patients in droves. With little public awareness of this problem, infection control remains a low priority. Historically, some vaccination programs have infected vast numbers of populations they were intended to protect.

Guess the country: between 2003 and 2007, the deaths of an estimated 2,000 hospital patients were linked to a virulent bacterial HAI that was spreading.³ According to that country's public health agency, "This is not a new disease; it's something that has been around for decades. It's just that people need to be reminded that proper hygiene—hand-washing and so forth—basically controls and stops the disease in its tracks." Is it some developing nation? A poor African country? An isolated relic like North Korea?

Staggeringly, the answer is *Canada*. We mention this incident not to denigrate Canada—for HAIs are scourges of the entire developed world—but to emphasize the extent of the problem. Even in the United States, nearly 100,000 people die from HAIs every year. Someone who is already sick—that is, a hospital patient—is especially susceptible to new infection, since his immunity is compromised. Whatever bug is going around is likely to flourish. Hospitals can be dangerous places.

Solutions are well known. Even before Louis Pasteur developed germ theory, nineteenth-century

physician Ignaz Semmelweiss understood enough about the transmission of infection to reduce the mortality rate of "childbed fever" from 10–35 percent to less than 1 percent by introducing hand-washing to his Viennese obstetric clinic. But even today, poor clinical practice or inappropriate treatment may expose patients to infections that are resistant to first-line drugs. Treatment then becomes difficult and extremely expensive, as New York City learned at great cost during a nosocomial outbreak of multi-drug-resistant tuberculosis in the early 1990s. For those suffering from bacterial infections, resistance to the most advanced antibiotics, such as methicillin, can be fatal.

In the poorest nations, it may not be a simple question of lapses in routine hygiene procedures, but rather ignorance of infection control and a lack of wherewithal to sustain it. Clean water and electricity, and even soap, may simply be unavailable. Where health facilities are out of reach both geographically *and* financially, patients seek care only as a last resort, after traditional medicine or self-treatment have failed. By then, they may be both severely prone to infection (with compromised immune systems) *and* highly infectious (with multiple pathogens, such as tuberculosis,

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hepatitis, and HIV). The clinic may be forced by lack of funds, equipment, electricity, and personnel to reuse injection and other equipment without proper sterilization. Medicines will be predominantly given by injection, and doses may be drawn repeatedly from the same bottle, often using the same needle and syringe. Even where disposable syringes are available, they may still be reused several times before being discarded—unsterilized—on a waste heap. There they become a valuable resource to scavengers who resell them—still unsterile—to people who use them to self-administer what may be unproven or counterfeit drugs bought from a street vendor. Such conditions are perfect for spreading disease to patients and throughout whole communities.

This is, of course, a worst-case scenario. But such events are far from rare in the developing world, although improvements are being made. In modern industrial countries, there are no excuses for dirty hands and dirty hospitals. Everyone has responsibility for infection control through practices such as good personal hygiene, cleaning cooking surfaces, and keeping sick children home from school. In hospitals, using sterile equipment with each patient is imperative. Perhaps familiarity makes it easy for us to forget the risks, but infection control is one of today's most serious but least appreciated public health threats.

Health Care: Hazardous to Your Health?

Mark Loeb, an infectious disease specialist at McMaster University in Hamilton, Ontario, said, "The key to halting its transmission is good infection control, including regular hand-washing by health providers between patients." Yet a recent study Loeb helped conduct at fifteen hospitals in Ontario showed that less than one-third of doctors and nurses washed their hands between patients as required by good practice. "The bottom line is no one's been able to develop a foolproof system to get health-care workers to wash their hands. That's really the holy grail of infection control."⁴

Denise Gravel, senior epidemiologist for the Public Health Agency of Canada's Nosocomial Infection Program, added that prevention also "boils down to basic housekeeping, and it's a matter of frequent cleaning, using the old elbow grease."⁵

In the United States, HAIs are estimated to occur in 5 percent of all acute care hospitalizations, resulting in more than \$4.5 billion in excess health care costs.⁶ According to a survey of U.S. hospitals by the Centers

for Disease Control and Prevention (CDC),⁷ HAIs accounted for about 1.7 million infections and about 99,000 associated deaths in 2002.⁸ The CDC reports: "The number of HAIs exceeded the number of cases of any currently notifiable disease, and deaths associated with HAIs in hospitals exceeded the number attributable to several of the top ten leading causes of death in U.S. vital statistics."

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But such revelations are apparently not shocking to the authorities or politicians. It seems that a certain level of HAIs is thought to be inevitable. Across the pond, Britain's Public Health Laboratory Service estimated in 1995 that with better application of present knowledge and realistic infection control practice, perhaps 30 percent of nosocomial infections could be avoided. Only 30 percent? A survey similar to the CDC's published by the UK National Audit Office in 2000 at the request of the House of Commons⁹ found that about 9 percent of inpatients suffered an HAI—at least 100,000 every year. The estimated extra cost to the National Health Service of dealing with these infections was £1 billion per year. Taken together, these two studies suggest that a "realistic" level of infection would be about 70,000 per year, and, assuming a similar death rate as that in the United States, this would mean over 9,000 deaths in England and Wales.

A comprehensive new study undertaken by Health Protection Scotland found 9.5 percent of people in acute care Scottish hospitals had an HAI.¹⁰ In forty-five acute care hospitals surveyed over a year, the study found 1,103 patients with an HAI, of which 126 had more than one infection. In twenty-two community hospitals, 157 patients had an HAI, of which seven had more than one. Rates in winter were higher—over 18 percent in one hospital.

The current attitude of openness within the health care community about the problem has led to new scientific research, such as a recent investigation into how long nosocomial pathogens can survive on dry surfaces. A long list was tested, with even more alarming results: the most common—Methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile*, *E. coli*, and tuberculosis—lasted for months on surfaces and remained continuous

sources of infection if no regular disinfection was performed. The study also flatly contradicts the common belief that HIV can last only a short time outside the body, stating that “blood-borne viruses, such as hepatitis B and HIV, can last over a week on dry surfaces.”¹¹

Britain’s chief medical officer, Sir Liam Donaldson, recently advocated providing hospital patients with their own supply of alcohol hand gel so that they can ask their doctors and nurses to clean their hands before examinations or procedures.¹² This method was tested at a hospital in Oxford and resulted in a 50 percent increase in compliance with routine disinfection procedures—but the disturbing corollary is that even when challenged, some medical staff carried on regardless, without washing. One patient interviewed felt it improper to ask nurses about hygiene, even after he had picked up MRSA in the hospital, which in turn led to his leg being amputated.¹³

Blood-Borne Infection: Not Borne Away

While diseases can be carried on hands, clothes, and dry surfaces, the risks are nothing compared with the direct introduction of pathogens into the blood by surgery, injections, transfusions, drip lines, and the like. Even pinpricks can transfer a large enough quantity of virus to take hold and replicate itself.¹⁴ In 1938, the *British Medical Journal* first documented post-transfusion hepatitis; in 1988, the *Journal of the American Medical Association* first recorded a case of transfusion-transmitted HIV.¹⁵ Nosocomial outbreaks caused by blood-borne transmission of malaria, syphilis, brucellosis, West Nile virus, Ebola virus, Chagas disease, and cytomegalovirus have also been well-documented. While blood transfusion is the surest route, transmission may also result from reusing unsterilized medical or dental equipment, accidental punctures with contaminated needles or sharp instruments (“needle-stick injury” is very common among clinical staff¹⁶), and exposure of non-intact skin or mucous membrane to infectious materials.¹⁷

Outbreaks of hepatitis between 2000 and 2005—mainly in nursing homes and assisted living centers—were tracked by the CDC, and all were found to involve diabetic patients who received routine finger-sticks for glucose monitoring. Investigations associated with these outbreaks identified hundreds of patients who acquired hepatitis B or C through breaches of aseptic techniques such as sharing syringes.¹⁸

The risk of infection from blood transfusion in developed Western countries has been greatly reduced in

recent years, in part due to health scandals in Canada, France, and the United Kingdom involving hemophiliacs infected with hepatitis C and HIV. Donors are now screened by interview, and those deemed to be at high risk are turned away, or their blood is discarded. All donated blood is tested for HIV, syphilis, hepatitis, and other diseases. In Britain, which now also tests for variant Creutzfeldt-Jakob disease, costs of supplying blood have increased by 56 percent over the past five years. A unit of blood now costs £130.¹⁹

Blood Safety in the Developing World

The challenges of maintaining a safe supply of blood in rich countries are magnified many times in developing countries, where even the basics—trained staff and cold-chain storage and transport—are lacking. On the one hand, many people die for lack of a blood transfusion, including women with complications in pregnancy, trauma victims, and children with severe life-threatening anemia as a result of malaria or poor nutrition. On the other hand, unsafe transfusion procedures and variable access to safe blood can also be fatal. We have personally observed that blood transfusions in the developing world, especially in India, are routinely offered at clinics without a physician being consulted.

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The World Health Assembly adopted a resolution in 1975 calling on all member states to promote national blood transfusion services based on voluntary, non-remunerated donations, as these were shown to be least prone to disease.²⁰ Unfortunately, many countries are far from this ideal situation. It is still common practice in the developing world for a family member to be directly hooked up to a patient to deliver untested blood, or worse still, for a clinic to buy blood from professional donors who make their living out of giving blood.²¹ These people and their behaviors are hard to monitor, and they tend to have abnormally high rates of HIV infection.²²

At the same time, blood transfusions are given when alternatives, such as intravenous replacement fluids, would be effective.²³ In cases in which blood donors are not screened or their samples tested, studies have shown that up to 25 percent of supplies may be infected with HIV.²⁴ The cumulative risks of contamination are considerable. If blood is pooled, for example, the whole supply will be contaminated; the equipment used to administer the blood will also become infected; those who are infected will become very ill, and before long, they will return to the hospital and again come into contact with equipment and syringes, which they will infect. Unless this equipment is thoroughly sterilized, it may go on to infect many other patients and possibly even clinical staff—beginning the cycle anew.

In 2004, on the first World Blood Donor Day (June 11), WHO reported that of the fifty-two countries in its European Region, only twenty-four had 100 percent voluntary, unpaid blood donation. “In Eastern Europe, where the national blood supply is mainly based on paid or family replacement donors, HIV prevalence has increased alarmingly during the last years, up to more than 40 times when compared with some Western European countries,” the report said.²⁵

The theme of World Blood Donor Day 2007 was “Safe Blood for Motherhood,” because severe bleeding during delivery or after childbirth contributes to about 34 percent of maternal deaths in Africa, 31 percent in Asia, and 21 percent in Latin America and the Caribbean. Children and pregnant women are the main groups of patients requiring blood transfusion in developing countries, and they are particularly vulnerable to blood shortages and to HIV, malaria, and hepatitis infections transmitted through unsafe blood.²⁶

For the past few years, WHO has compiled data on blood collection and testing, and although the situation has improved, 46 countries of the 172 under review are still collecting more than 75 percent of their blood supplies from family members or paid agents. In sub-Saharan Africa, twenty-eight of forty countries have not established quality-assurance blood testing for HIV and hepatitis.²⁷

The impact that access to safe blood can have on health outcomes for pregnant women with severe bleeding, however, is profound. In 2003, Malawi established a blood transfusion service; by 2005, the maternal mortality rate due to severe blood loss had fallen by more than 50 percent.²⁸ In 1990, Uganda was emerging from years of civil war and war with Tanzania, with HIV prevalence among pregnant women of perhaps 30 percent²⁹ and a

ruined health infrastructure. With the help of a project led by the European Commission, Uganda Blood Transfusion Services (UBTS) was established, modeled on a project pioneered by Zimbabwe and based at the Nakasero Blood Bank in Kampala. This was far from easy, but by the mid-1990s, UBTS was supplying all the country’s needs with screened and tested blood. By 1990, HIV prevalence had dropped to 9 percent, and the latest figures show a prevalence of 7 percent, peaking at 10.7 percent in the thirty- to thirty-four-year-old age group.³⁰ It is most heartening that prevalence in the fifteen- to nineteen-year-old age group has dropped to 2.2 percent. The work of UBTS has been well-documented,³¹ but it is largely overshadowed in government publicity by the country’s voluntary counseling and testing services, even though UBTS director Peter Kataaha believes safe blood for transfusion is “one of the major instruments of AIDS control in the country.”³² But that does not mean that it is sufficiently funded.

Unsafe Injections

Lack of money has sometimes been less of a problem, however, than unwillingness to acknowledge the risk in the first place. Outbreaks of malaria among soldiers during World War I were linked to injection treatments for syphilis.³³ After World War II, there were many similar stories linking immunizations and jaundice (probably hepatitis C). It was established in 1950 that syringes become contaminated with blood because negative pressure is generated when the needle is removed. Even so, it took until 1987 for the medical community in industrialized countries to adopt the policy of “one sterile syringe and needle for each patient.”³⁴ The later introduction of disposable syringes also largely reduced the problem of needle-stick injuries to healthcare workers in the industrialized world.³⁵

Sadly, progress is much slower in the developing world, where injection is one of the most common health care procedures. WHO estimates that at least 16 billion injections are given every year in developing and transitional countries.³⁶ Less than 5 percent of these are immunizations; over 70 percent are unnecessary or could be given orally. Patients believe injections deliver faster, stronger medicines, and doctors overprescribe injections to satisfy them. In some cases, nine out of ten patients receive an injection at every visit.³⁷

Immunization injections are generally thought to be safer than curative injections delivered in clinics,³⁸ but

mass immunization campaigns in the past have not been as fastidious about hygiene as they ought to have been.³⁹ As recently as 1998, WHO still recommended reuse of syringes up to 200 times in vaccination programs, relying on sterilization routines that WHO's own studies showed were not usually followed.⁴⁰ A vaccination campaign in Egypt against schistosomiasis, a common tropical disease caused by a parasite, saw more than 3 million injections per year between 1964 and 1969. According to *The Lancet*, "By the mid 1980s the campaign had infected 10 percent of the entire adult population of Egypt with hepatitis C, and it constituted the world's largest iatrogenic (nosocomial) transmission of blood-borne pathogens known to date."⁴¹

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Assessments carried out by WHO in numerous countries have revealed that syringes and needles are often just rinsed in a pot of tepid water between injections. Worldwide, up to 40 percent of injections are given with syringes and needles reused without sterilization. In some countries, this proportion is as high as 70 percent.⁴²

Other unsafe practices, such as poor collection and disposal of used injection equipment, expose health care workers and the community at large to the risk of needle-stick injuries.⁴³ In some countries, unsafe disposal can lead to resale of used equipment on the black market.⁴⁴ In 2004, half of nonindustrialized countries reported that they still incinerated syringes on open bonfires, a practice considered unacceptable by WHO.⁴⁵ The global health agency is now taking action. Its Safe Injection Global Network (SIGN)⁴⁶ met for the first time in October 1999, noting that a recent mathematical model⁴⁷ suggested that unsafe injections may cause 8–16 million cases of hepatitis B, 2.3–4.5 million cases of hepatitis C, and 80–160,000 cases of HIV annually worldwide. One assumption of these modeled estimates was that each person received one-and-a-half to two injections per year, but contemporaneous evidence reveals that "institutionalized children, and children and

adults who are hospitalized, including those infected with HIV, are often exposed to 10 to 100 times as many injections"—increasing their risk exposure far beyond what the models would suggest.⁴⁸

The efficiency with which HIV or any other blood-borne pathogen can be transmitted in health care settings has long been appreciated. A well-documented explosive outbreak of HIV in Romania in the 1980s that affected hundreds of orphans, hemophiliacs, and other blood recipients was traced to a single imported HIV-infected blood product. The subsequent nosocomial transmission resulted from "improper medical practices."⁴⁹ Clearly, in cases in which proper infection control procedures are not followed, far more patients are at risk of infection than the direct recipients of the infected blood.

The "Benghazi Six" affair in Libya began in exactly this way. The case involved over four hundred children infected with HIV in 1998 during their stays at a Benghazi children's hospital while under the care of six foreign medical workers. Over fifty of the children have now died. The Libyans seized upon the infections as a foreign plot, later admitting that they tortured the five Bulgarian nurses and one Palestinian doctor until they confessed to infecting the children. They were charged with murder but eventually extradited to Bulgaria, and all charges were dismissed.⁵⁰ Notwithstanding accusations of espionage and sabotage made by the Libyans, expert virologists are convinced that the cause was widespread failure to maintain infection control procedures. In fact, it is believed that a single child was infected in the hospital and then readmitted when very sick. "Poor medical procedures or sterilization procedures will rapidly translate into a number of new HIV infections," said Swiss virologist Luc Perrin. "What we observed can be explained by the reuse of syringes or poor sterilization procedures."⁵¹

Certainly when the outbreak happened in the late 1990s, Libyan authorities may not have been aware of the true risks of HIV transmission through unsafe injections, but even now, misconceptions persist. Far too many public health workers believe that HIV may not be readily transmitted by reused needles.⁵² This is seriously challenged as "dangerous" by the authors of a recent study, which tested for HIV in needles that had been used on 191 HIV-infected patients receiving injections in rural Cameroon.⁵³ The study found that

thirty-three per cent (34 out of 103) of the syringes used for intravenous injections in HIV-seropositive

individuals contained amplifiable virus; two percent (two out of 88) of the syringes used for intramuscular injections contained amplifiable virus. By showing that HIV-1 RNA was present in more than thirty percent of syringes used for intravenous injections, we provided proof of concept that injection practices could account for a significant proportion of new HIV infections.⁵⁴

In other words, a *third* of the syringes used on HIV patients contained enough of the virus to infect another person if that syringe were reused. It should also be noted that other diseases, such as hepatitis and malaria, are far more easily transmitted than HIV.

The Injection Connection: Overwhelming Evidence

Developing countries, especially in sub-Saharan Africa, are plagued and kept in poverty by infectious diseases. Health facilities are rare, and where they do exist, they may be causing more harm than good. Many countries rely mainly on foreign aid-financed health care, and the lion's share is often spoken for by antiretroviral treatments for HIV. But the transmission of HIV is imperfectly understood, and the common acceptance that the virus is predominantly sexually transmitted⁵⁵ is being gradually overturned by new evidence that supports the argument that medical injections play a significant role in its transmission.

In the past year, a study in Zambia led by the CDC found that medical injections—whether into muscle or veins—“were overwhelmingly correlated with HIV prevalence, exceeding the contribution of sexual behaviours in a multivariable logistic regression.”⁵⁶ The study recruited young, healthy women, pregnant with their first children, who were being seen at the University Teaching Hospital in Lusaka between 1989 and 2001. To be eligible, the women had to be free of diseases that affect the immune system, so clinical evaluations, medical record searches, and self-reporting were undertaken. Detailed data were collected on demographic, medical, cultural, and sexual behavior variables. On all these criteria the women were in the low-risk category for HIV—they were largely monogamous (90.3 percent were married; 89 percent had had no other sexual partners in the previous three years) and were reasonably well-off and educated (93.2 percent had at least primary education; 5.5 percent had

more than secondary education)—and yet 30.3 percent were found to be HIV positive.

That nearly a third of the sample was HIV positive was startling because these women were recruited specifically because they were healthy and at low risk of infection. In fact, the study found that the most significant risk factor to which these women had been exposed was going to a clinic and having an injection. As the authors conclude, “medical injection history made an overwhelming contribution to explaining prevalent HIV-infection, even after demographic variables, sexual behaviours, and substance abuse were already parcelled out of . . . the . . . equation.” In this study, all risk factors were compared with each other for perhaps the first time, and the results seriously undermine current public health messages on HIV. The study's results also suggest that efforts to prevent disease transmission in health care and daily life would be very cost-effective.

What to Do? First, Do No Harm

For too long, the medical and public health professions have regarded incidental infection as an acceptable side effect. Even now, the problem is obscured by language—nosocomial; iatrogenic; hospital- or health care-acquired infection—and by statistics which are difficult to put into context. The United States, which has collected statistics on HAIs for more than thirty years, is unusual in its frankness about its own nosocomial infections. But the problem still persists on a shocking scale. For the developed world, proper hygienic procedures are written down, taught, and financed. They have not been observed. It seems that we must be forced or incentivized to maintain hygiene.

In a bygone era, hospital hygiene enforcement was the responsibility of the head nurse or matron, so perhaps this role could be reinterpreted for the modern age. This trend, started by nursing pioneers Florence Nightingale and Mary Seacole, dramatically improved the survival chances of the wounded in the Crimean War (1854–56).⁵⁷ Overall responsibility for hygiene and infection rates should be taken by the highest level of management. Cleaning contracts should be scrutinized, and work verified. Clinical staff must be scrupulous in their personal hygiene and in the procedures they undertake. The example given on page 3 of the man who contracted MRSA and had his leg amputated raises the possibility of litigation against the doctor, staff member, or hospital in question. Medical malpractice litigation is

limited in the United Kingdom, however, so liability is most likely to lead to positive change in the United States. In any health care setting, corner-cutting in hygiene is a false economy, and the costs do not fall on the perpetrators but on the patients, their insurance providers, and taxpayers. In human terms, of course, the often fatal consequences of unhygienic and dangerous practices fall directly on the patients and their families.

WHO has a clear role to play, but it seems reluctant. Recently, director-general Margaret Chan called for action and cooperation to limit the spread of infection, emphasizing that thirty-nine new pathogens have emerged since 1967, but she focused on globalization and increased mobility as causes.⁵⁸

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Those at risk from tainted blood are not evenly distributed around the world. They are concentrated in institutions and hospitals, mostly in developing countries, and they are at risk of far more than HIV. WHO seems to have abandoned mass immunization programs with almost no discussion, perhaps to avoid admitting past mistakes like those in Egypt. But WHO should take the lead in promoting safe injections as a high priority, and there is still great need for large-scale vaccinations—if they are done right.

The situation is not hopeless, however. Many countries are helping themselves, and several of them—including Uganda and South Africa—have demonstrated to others the benefits of clean blood and safe injections. Namibia and Zimbabwe have also achieved a safe blood supply, although Zimbabwe may not be able to sustain it.

Donors have also started to address the problem, with Congress earmarking \$75 million for clinics in the developing world for infection control.⁵⁹ The President's Emergency Plan for AIDS Relief (PEPFAR) has allocated \$150 million over five years for safer medical injections and related projects, including capacity-building, changing behavior, reducing demand for injections, and improving management of used clinical supplies.

The Safe Injection Global Network promotes good practices and appears to be making a difference. For example, all immunization programs promoted by SIGN members include some kind of single-use syringe, individual-dose vials, and safety boxes for used syringes, all bundled in the right proportions. Glycerine-alcohol hand rubs are promoted, especially when nurses travel to remote locations, and these can often be produced locally, which reduces costs.

Some public health professionals in the aid community have considered it unadvisable to make the risks of unsafe blood and injections known to the public. Studies have shown, however, that programs that educate patients on injection safety and promote oral medication instead of injections neither jeopardize other programs such as condom distribution nor undermine confidence in health services. Indeed, since it is customary to pay for injections, few participants have objected to paying a small extra charge for a sterile syringe when an injection is unavoidable.⁶⁰ There is room for public education on the standards of hygiene that patients should demand *everywhere* in the world.

Infection control practices are unglamorous and mundane and require constant diligence, but failure to maintain hygiene will mean that infection rates never diminish. Western teaching hospitals attended by overseas medical students must be especially vigilant, because the hygiene habits acquired there will be continued when qualified staff return to their home countries to practice. While the principles of infection control are universal, the exact procedures must be tailored to suit local customs and expectations, and the ultimate safe disposal of waste depends on local authorities.

This is the approach taken by the Making Medical Injections Safer Project—implemented by health care consultancy John Snow, Inc., and funded by PEPFAR—which trains and supervises health care workers in safe injection and infection control practices and new technologies. It procured 85 million safety syringes in 2006, allowing national governments to decide which type they found preferable. Country teams developed appropriate strategies to reduce the demand for injections and ensure safe practices in use and disposal of needles and syringes.

These practices must be upheld by long-term training and supervision, but PEPFAR is only a five-year program. Only 20 percent of PEPFAR's budget is for HIV prevention, of which more than half is directed toward preventing sexual transmission. Ensuring safe injections

and making safe blood available countrywide relies on increasing capacity and improving infrastructure, but for much of sub-Saharan Africa the roads are poor and may disappear altogether in the rainy season. Water and electricity are unreliable, making cold-chain transport almost impossible, so PEPFAR's meager funding allowance is being stretched a long way.

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Clearly, good infection control will not be achieved solely with a universal, top-down approach, but will rather require multilateral cooperation and large-scale individual support. This requires sharing knowledge and research, but also practical measures, from supplying protective medical equipment like gloves, masks, and clothing to developing cheap, transportable, temporary road structures to allow medical supply chains to cross flooded areas. Innovative solutions are needed to provide clean water, electricity, and refrigeration in remote areas. Supplies of injection equipment and safe means of disposal must be reliable. Even taking pills can be problematic without water to accompany them, so small quantities of clean water in disposable packaging might be developed to be dispensed along with medication. For small children and babies, dose-sized flexible vials with a break-off top could deliver medicines in liquid form for oral administration. Once the public health establishment properly acknowledges the problem, solutions can be found.

Large aid organizations must place a higher priority on infection control and incorporate appropriate procedures, systems, equipment, and oversight into all their programs. In all health care settings around the world, infection control should not be seen as a nicety, but rather as a necessity. There is no justification for health care providers to cure with one hand and infect with the other.

AEI research assistant Karen Porter and editorial assistant Evan Sparks worked with Ms. Mooney and Mr. Bate to edit and produce this Health Policy Outlook.

Notes

1. Also known as health care–acquired, nosocomial, or iatrogenic infections.

2. Gerald Dziekan, "Healthcare Associated Infections: Health and Economic Implications," in *Report of the Global Injection Safety and Infection Control Meeting* (Geneva: World Health Organization [WHO], 2006), 26, available at www.who.int/injection_safety/Final-SIGNHanoiReport22March06.pdf (accessed September 27, 2007). HAI prevalence in the United States is estimated to be 5–15 percent; in the European Union, 3.5–14.8 percent. Data for developing countries are patchy, but Mexico's prevalence is 23.3 percent and Malaysia's is 29.2 percent. Global estimated average mortality is 10 percent.

3. A particularly virulent strain of *Clostridium difficile*, NAP1, has been tracked by the Public Health Agency of Canada; the deaths occurred in Quebec. Sheryl Ubelacker, "Hospital Bug *C. difficile* Can Cause Severe Illness, Suffering, Say Patients." Canadian Press, March 4, 2007.

4. Ibid.

5. Ibid.

6. Quoc V. Nguyen, "Hospital-Acquired Infections," eMedicine, August 21, 2007, available at www.emedicine.com/ped/topic1619.htm (accessed September 27, 2007).

7. R. Monina Klevens et al., "Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002," *Public Health Reports* 122 (March/April 2007), available at www.cdc.gov/ncidod/dhqp/pdf/hicpac/infections_deaths.pdf (accessed September 27, 2007).

8. Centers for Disease Control and Prevention, "Estimates of Healthcare Associated Diseases," May 30, 2007, available at www.cdc.gov/ncidod/dhqp/hai.html (accessed July 17, 2007).

9. National Audit Office, *The Management and Control of Hospital Acquired Infection in Acute NHS Trusts in England*, February 17, 2000, available at www.nao.org.uk/pn/9900230.htm (accessed September 27, 2007).

10. Health Protection Scotland, *NHS Scotland National HAI Prevalence Survey: Final Report*, 2 vols. (Edinburgh: Health Protection Scotland, July 2007), available at www.hps.scot.nhs.uk/haiic/publicationsdetail.aspx?id=34832 and www.hps.scot.nhs.uk/haiic/publicationsdetail.aspx?id=34833 (accessed September 27, 2007); and Lyndsay Moss, "One in Ten Scottish Hospital Patients 'Suffering Infection,'" *Scotsman*, July 12, 2007.

11. Axel Kramer, Ingeborg Schwebke, and Günter Kampf, "How Long Do Nosocomial Pathogens Persist on Inanimate Surfaces? A Systematic Review," *BMC Infectious Diseases* 6 (August 16, 2007): 130. Emphasis added. The most common nosocomial pathogens may survive or persist on surfaces for months and can therefore be a continuous source of transmission

if no regular preventive surface disinfection is performed. Most gram-positive bacteria, such as *Enterococcus* spp. (including VRE), *Staphylococcus aureus* (including MRSA), and *Streptococcus pyogenes*, survive for months on dry surfaces. Many gram-negative species, such as *Acinetobacter* spp., *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, *Serratia marcescens*, and *Shigella* spp., can also survive for months. A few others, such as *Bordetella pertussis*, *Haemophilus influenzae*, *Proteus vulgaris*, or *Vibrio cholerae*, however, persist only for a matter of days. Mycobacteria, including *Mycobacterium tuberculosis*, and spore-forming bacteria, including *Clostridium difficile*, can also survive for months on surfaces. *Candida albicans*, the most important nosocomial fungal pathogen, can survive up to four months on surfaces. Other yeasts can persist for as long as five months (*Torulopsis glabrata*) or as little as fourteen days (*Candida parapsilosis*). Most respiratory tract viruses, such as corona, coxsackie, influenza, SARS, and rhino virus, can persist on surfaces for a few days. Viruses from the gastrointestinal tract, such as astrovirus, HAV, poliovirus, and rota virus, persist for approximately two months. Blood-borne viruses, such as HBV and HIV, can persist for more than one week. Herpes viruses, such as CMV and HSV type 1 and 2, have been shown to persist from only a few hours to up to seven days.

12. Rebecca Smith, "Patients Should Tell Doctors to Wash Their Hands," *Daily Telegraph* (London), July 18, 2007.

13. Ibid.

14. D. J. Hu, M. A. Kane, and D. L. Heymann, "Transmission of HIV, Hepatitis B Virus, and Other Bloodborne Pathogens in Health Care Settings: A Review of Risk Factors and Guidelines for Prevention," *WHO Bulletin* 69, no. 5 (1991): 623–30.

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