

The cost of unsafe injections

M.A. Miller¹ & E. Pisani²

Unsafe injection practices are associated with substantial morbidity and mortality, particularly from hepatitis B and C and human immunodeficiency virus (HIV) infections. These inadvertently transmitted bloodborne diseases become manifest some considerable time after infection and hence may not be appropriately accounted for. Annually more than 1.3 million deaths and US\$ 535 million are estimated to be due to current unsafe injection practices. With the global increase in the number of injections for vaccination and medical services, safer injecting technologies such as auto-disable syringes must be budgeted for. Investment in health education and safer disposal will also reduce infections associated with unsafe injecting practices. Safer injecting practices are more expensive than current less safe practices, but the additional cost is more than offset by the reduction in disease that would result.

Keywords: costs and cost analysis; hepatitis B; HIV infections; immunization programmes; risk factors; syringes.

Voir page 810 le résumé en français. En la página 810 figura un resumen en español.

The transmission of hepatitis from patient to patient through the use of unsterilized needles has been recorded for over half a century (1), and yet the problem persists on a substantial scale in many countries (2). It is estimated that 8–12 billion (8–12 thousand million) injections are given in health care settings around the world each year (3, 4). In the developing world, more than 50% of these are thought to be unsafe, exposing patients to the risk of infection with hepatitis, human immunodeficiency virus (HIV) and other bloodborne pathogens (5).

Model-based estimates suggest that unsafe injection practices contribute significantly to HIV infection and very substantially to hepatitis B and C infection, with consequent mortality (3, 6). On the basis of regional prevalences of disease, unsafe injecting practices and case fatality rates, it is estimated that unsafe injections may infect more than 80 000 people a year with HIV, and more than 10 million with hepatitis viruses. Collectively, these infections may cause over 1.3 million premature deaths a year in subsequent birth cohorts (Table 1, Fig. 1) (7). At current average treatment expenses for each region, such infections may cost the world more than US\$ 535 million per year in direct medical expenditures. In view of the estimated annual 4.3 billion injections in the developing world, this amounts to a premium of US\$ 0.125 of “hidden costs” per injection, exceeding the marginal costs of improved technologies, such as auto-disable syringes. These estimates will need to be refined as better data become available and more sensitive models are

developed, but they are sufficient to indicate that the problem is clearly of such magnitude that it requires urgent attention.

Routine immunization programmes account for approximately 750 million injections per year — less than one-tenth of the global total. Such injections are believed to be safer than many non-immunization injections in most countries. However, WHO recently estimated that up to one-third of immunization injections were unsafe in four out of six regions of the world (4, 8). The advent of new vaccines and the possibility of national campaigns to eliminate measles are likely to add more than 400 million injections per year to the total number given to infants and children.

It is inevitable that attention to safer injecting practices will crystallize first around immunization programmes, and rightly so. These programmes are designed to prevent disease later in life. If unsafe injecting practices transform them into sources of infection with other diseases, they may continue to meet their immediate goals, but they will defeat their ultimate purpose.

The large number of injections given to children in their first years of life may expose them repeatedly to the dangers of unsterile equipment and consequent disease. The majority (70–90%) of children infected with hepatitis B will become chronic carriers, compared with 6–10% of people infected as adults. Among chronic carriers, 20–28% will die of causes related to their hepatitis infection (9). Health care workers are often overwhelmed by the immediate threat posed by diseases of childhood. Since hepatitis, even more than HIV, remains silent for many years, it is easy for them to overlook the threat that unsafe injecting practices pose to their clients later in life.

Ensuring safe injection practices is essential for maintaining public confidence and extending the reach of immunization programmes. Participation

¹ Medical Officer, Children's Vaccine Initiative, c/o World Health Organization, 1211 Geneva 27, Switzerland (e-mail: millermark@who.ch). Correspondence should be addressed to this author.

² Consultant, Children's Vaccine Initiative, c/o World Health Organization, 1211 Geneva 27, Switzerland.

rates in immunization programmes drop rapidly following negative publicity about adverse effects of injecting, whether or not the unsafe injections in question were vaccine-related. Health workers and policy-makers therefore have a two-fold interest in promoting safety in all health sector injections: to reduce iatrogenic infections; and to ensure confidence in public health programmes.

Immunization programmes are frequently a major source of injection equipment in developing countries. In some countries, four out of five disposable syringes, many of them supplied for vaccination, are reused (4, 10). Around the world, less than 10% of syringes are supplied with special safe disposal boxes. Health ministries and other agencies supporting vaccination efforts have a responsibility to ensure that the injecting equipment they introduce into the health system does not become a health hazard. Increasing the safety of medical injections requires improved technologies as well as better use of existing technologies.

Because they have strong political and often financial support, immunization programmes should be able to take a lead in encouraging the widespread use of better technology. Technologies such as auto-disable syringes supplied with safe disposal boxes may be adopted more widely throughout the health system if they are first promoted through such programmes (11).

The standards set by vaccination programmes for alternative technologies ought to be carefully scrutinized. The use of jet injectors is currently in abeyance because, although they may be effective in mass immunization campaigns, existing models carry a non-negligible risk of person-to-person infection. Zero tolerance of cross-infection through jet injectors has led to a demand for the development of jet-injecting technology that is absolutely safe. In the meantime, however, disposable syringes continue to be reused outside of immunization programmes leading to high risk of infection (person-to-person, person-to-health-worker and environmental). Clearly, there is a mismatch in the expectation of future technologies and the tacit acceptance of today's standard practices.

Over 90% of medical injections are given outside immunization programmes (5). Most are intended for curative purposes, and many are probably unnecessary. The pressure to provide injections comes from both patients and doctors. To reduce the demand for unnecessary injections and increase the demand for sterile injections certainly requires increased public awareness, health worker training, and the provision of alternative oral medications. It may also be necessary to make structural changes in health service provision to reduce incentives to provide injections. Such changes are likely to be costly and time-consuming. However, new efforts are under way with health partners joining forces in the newly formed Safe Injection Global Network (SIGN).

Table 1. **Estimated global annual incidence, deaths, years of life lost, and cost resulting from unsafe injection practices for hepatitis B, hepatitis C and human immunodeficiency virus (HIV) infections using best case assumptions (i.e. minimizing disease burden and costs)**

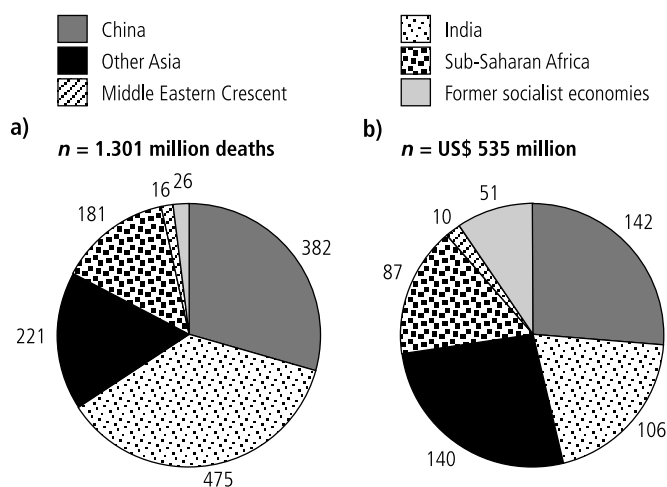
	Hepatitis B	Hepatitis C	HIV	Total
Annual incidence of infections from unsafe injections (x 10 ⁶) ^a	8.2	2.3	0.1	10.6
Future deaths (x 10 ⁶) ^b (ref. 7)	1.0	0.2	0.1	1.3
No. of years of life lost (x 10 ⁶) ^c (ref. 14)	19.7	3.6	2.7	26.0
Direct medical cost of disease (x 10 ⁶ US\$) (ref. 7)	327	59	149	535

^a Annual incidence of deaths assumed minimal infection rates (ref. 6).

^b Future deaths from hepatitis based on 70% and 80% of infections progressing to a carrier state for hepatitis (exception for countries within the former socialist economies of Europe and Eastern Mediterranean countries where carriage per infection was assumed to be 10% due to later age of acquisition). No. of deaths based on 20%, 10%, and 100% mortality of carrier states for hepatitis B, C and HIV, respectively.

^c No. of years of life lost based on current life expectancy for each country. Average age of death was assumed to be 45 years for hepatitis B and C; 30 years for HIV.

Fig. 1. **a) Point estimates of mortality and b) costs of disease due to unsafe injections.** a) Point estimates of mortality (ref. 7) due to human immunodeficiency virus (HIV), hepatitis B and hepatitis C infections from unsafe injections (ref. 6). In developing countries, cross-infections with hepatitis B were assumed to occur early in life, with 70% of persons progressing to a chronic carrier state with a 20% mortality (ref. 9). HIV cross-infections were assumed to have a case fatality rate of 100%. b) Cost of disease for hepatitis (US\$ 90–490) (ref. 15) and HIV (US\$ 990–9100) (ref. 16, 17) for each region were based on countries with similar economies



Responding to the problem of unsafe injections requires a better understanding of where the problem lies. It is likely that the bulk of infection from injections arises from reuse of contaminated injecting equipment (5). Auto-disable syringes, which cannot

be reused, would do much to cut down infection. Likewise, investments need to be made in safe, convenient and effective disposal of injection equipment to avoid the spread of infection among health workers and the public. In addition, greater priority should be given to support needle-less technology, such as aerosol or oral formulations of vaccines.

The availability of such information will affect cost analyses and hence policy decisions. Cost calculations must take into account reality rather than a notional ideal. An auto-disable syringe, for example, costs around US\$ 0.085 (12) — just over twice the price of a disposable syringe — and it may deliver up to 15% more vaccine per injection than a disposable (13). But in practice, a disposable syringe, purchased for US\$ 0.04, may be inappropriately reused many times. If a single disposable syringe is reused 20 times, its price falls to less than one-fortieth of that of an auto-disable syringe but defeats the ultimate goal of disease control causing far greater increased cost from transmitted pathogens.

Equally, the cost of adverse events should be compared across diseases and time. Immediate

adverse reactions to measles vaccine, for example, are relatively rare. However, if unsafe injecting practices during vaccination campaigns deliver HIV or hepatitis viruses along with immunity to measles, these potential infections must certainly be considered adverse events. While measles control through immunization is clearly one of the most cost-effective public health interventions, adequate investments must be made to ensure that vaccine is delivered safely, especially in the setting of large immunization campaigns.

Needles that deliver medication or vaccines should not be vectors of disease. International organizations such as WHO and UNICEF have a responsibility to take the lead in encouraging safer injecting practices. An important first step in expanding their existing commitment in this respect is to quantify better the scale of the problem, the social and financial burden it represents in terms of mortality and morbidity, and the costs of alternative strategies to reduce that burden. Better information will lead to a more rational analysis of the true costs of medical injections. ■

Résumé

Coût des injections pratiquées dans de mauvaises conditions d'hygiène

Les injections pratiquées dans de mauvaises conditions d'hygiène sont associées à des taux élevés de morbidité et de mortalité, imputables en particulier aux virus des hépatites B et C et au virus de l'immunodéficience humaine (VIH). Ces maladies transmises de façon accidentelle par voie sanguine se manifestent cependant longtemps après l'administration des premiers vaccins et leur cause n'est donc pas toujours élucidée. Les pratiques vaccinales actuelles seraient responsables chaque année de plus de 1,3 million de décès et entraîneraient des dépenses de l'ordre de US \$535 millions.

Les infections associées aux injections sont probablement dues pour l'essentiel à la réutilisation de matériel d'injection contaminé. L'emploi de seringues autobloquantes réduirait donc la prévalence de ces infections. Il conviendrait en outre d'investir dans des méthodes sûres, pratiques et d'un bon rapport coût-efficacité pour éliminer le matériel d'injection ou dans des technologies sans aiguilles.

Etant donné l'augmentation mondiale du nombre des injections effectuées pour les services médicaux et de vaccination, des crédits suffisants doivent être prévus pour accroître la sécurité des techniques d'injection telles que les seringues autobloquantes, tout en améliorant l'éducation sanitaire et les dispositifs d'élimination du matériel. Bien que d'un coût plus élevé que les pratiques dangereuses actuelles, la réduction de la morbidité qui résulterait de l'amélioration des méthodes compenserait probablement les investissements destinés à améliorer les pratiques d'injection.

Il incombe aux organisations internationales telles que l'OMS et l'UNICEF d'encourager l'emploi de méthodes d'injection plus sûres. Il conviendrait à cet égard de commencer par mieux définir l'ampleur du problème, son poids social et financier en termes de morbidité et de mortalité, et le coût d'autres stratégies propres à réduire ce fardeau.

Resumen

Costo de las inyecciones peligrosas

Las prácticas peligrosas de inyección causan una importante morbilidad y mortalidad, sobre todo como consecuencia de la transmisión de los virus B y C de la hepatitis y del virus de la inmunodeficiencia humana (VIH). Sin embargo, estas enfermedades transmitidas inadvertidamente por la sangre se manifiestan mucho tiempo después de la inmunización primaria y en consecuencia no se tienen debidamente en cuenta. Se calcula que anualmente las actuales prácticas de

inmunización se cobran más de 1,3 millones de vidas y cuestan US\$ 535 millones.

Probablemente la mayoría de las infecciones por inyecciones se debe a la reutilización de material contaminado. Así pues, el uso de jeringas autodestruíbles reduciría la prevalencia de tales infecciones. Es necesario además invertir tanto en sistemas seguros, cómodos y eficientes de eliminación del material de inyección como en técnicas que prescindan de agujas.

Ante el aumento mundial del número de inyecciones empleadas para vacunación o en los servicios médicos, es necesario prever las asignaciones presupuestarias apropiadas para implementar técnicas de inyección más seguras, por ejemplo las jeringas auto-destruibles, y mejorar al mismo tiempo la educación sanitaria y las unidades de eliminación. Aunque más costosos que las actuales prácticas peligrosas, los métodos mejorados harían posible una disminución de la morbilidad que probablemente compensaría las

inversiones realizadas en la mejora de las prácticas de inyección.

Organizaciones internacionales como la OMS y el UNICEF tienen la responsabilidad de impulsar el empleo de métodos de inyección más seguros. A este respecto, un primer paso importante consistiría en cuantificar mejor la magnitud del problema, la carga social y financiera que representan la morbilidad y la mortalidad asociadas, y el costo de las estrategias alternativas de reducción de esa carga.

References

1. **Gold AH, Schoenfeld J, eds.** *From crisis to opportunity: hypodermic syringe related papers and letters 1933–1997*. Garden City, NY, UNIVAC Medical Devices, 1997.
2. **TECHNET consultation, Copenhagen, 16–20 March 1998**. Geneva, World Health Organization, 1998 (unpublished document WHO/EPI/LHIS/98.05; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
3. **Aylward B et al.** Model-based estimates of the risk of human immunodeficiency virus and hepatitis B virus transmission through unsafe injections. *International journal of epidemiology*, 1995, **24**: 446–452.
4. **State of the world's vaccines and immunization**. Geneva, World Health Organization, 1996 (unpublished document WHO/GPVI 96.04; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
5. **Simonsen L et al.** Unsafe injections in the developing world and transmission of blood-borne pathogens. *Bulletin of the World Health Organization*, 1999, **77**: 789–800.
6. **Kane A et al.** Transmission of hepatitis B, hepatitis C and human immunodeficiency viruses through unsafe injections in the developing world: model-based regional estimates. *Bulletin of the World Health Organization*, 1999, **77**: 801–807.
7. **Miller MA.** Hidden costs of unsafe injections. In: *TECHNET consultation, Copenhagen 16–20 March 1998*. Geneva, World Health Organization, 1998 (unpublished document WHO/EPI/LHIS/98.05; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
8. **Technical network for logistics in health Manila consultation '96**. Geneva, World Health Organization, 1996 (unpublished document WHO/EPI/LHIS/97.02; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
9. **Beasley RP, Hwang LY.** Epidemiology of hepatocellular carcinoma. In: Vyas GN, Dienstag JL, Hoofmagle JH, eds. *Viral hepatitis and liver disease*. Orlando, FL, Grune & Stratton, 1984, 209–224.
10. **GPV declares war on unsafe injections.** *Vaccine and immunization news*, 1997, **5**: 1–5 (appears also as unpublished document WHO/GPV/VIN/97.03; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
11. **WHO–UNICEF policy statement for mass immunization campaigns**. Geneva, World Health Organization, 1997 (unpublished document WHO/EPI/LHIS/97.04; available upon request from Vaccines and other Biologicals, World Health Organization, 1211 Geneva 27, Switzerland).
12. **Aylward B et al.** Reducing the risk of unsafe injections in immunization programmes: financial and operational implications of various injection technologies. *Bulletin of the World Health Organization*, 1995, **73**: 531–540.
13. **Nelson CM, Sutanto A, Suradana IG.** Use of SoloShot autodestruct syringes compared with disposable syringes, in a national immunization campaign in Indonesia. *Bulletin of the World Health Organization*, 1999, **77**: 29–33.
14. **Miller MA, McCann L.** Policy analysis of the use of hepatitis B, *Haemophilus influenzae* type b, *Streptococcus pneumoniae* conjugate and rotavirus vaccines in national immunization schedules. *Health economics* (in press).
15. **Miller MA, Hinman A.** Cost benefit and cost effectiveness analysis of vaccine policy. In: Plotkin S, Orenstein W, eds. *Vaccines*, 3rd edit. Philadelphia, W. B. Saunders, 1999: 1074–1088.
16. **Tarantola D et al.** Projecting the course of the HIV/AIDS pandemic and the cost of adult AIDS care in the world. In: Kaplan E, Brandeau ML, eds. *Modeling the AIDS epidemic: planning policy, and prediction*. New York, Raven Press, 1994.
17. **Martin AL.** The cost of HIV/AIDS care. In: Mann JM, Tarantola DJM, eds. *AIDS in the world. II. Global dimensions, social roots and responses. The Global AIDS Policy Coalition*. New York, Oxford University Press, 1996.