Unsafe injection practices including the reuse of needles and syringes are a common public health problem in many countries and contribute to an estimated 40 per cent hepatitis C, 32 per cent hepatitis B, and 5 per cent human immunodeficiency virus (HIV) infections each year. In South Asia, unsafe
injections account for up to 9 per cent of new HIV infections. The reasons for unsafe injections are complex and include structural, economic and socio-cultural factors. Many injections are given unnecessarily because patients overvalue them compared to oral medication, and healthcare practitioners overprescribe them. Additionally, knowledge regarding injection safety among injection prescribers, providers and consumers is often suboptimal.

In many countries, including India, therapeutic injections are provided in the formal sector by trained, allopathic healthcare practitioners such as doctors, nurses and others, and in the informal sector where (allopathic) injections are given by non-allopathic practitioners including traditional healers. Many practitioners of Indian traditional medicines such as Ayurveda and homeopathy and others inject a range of allopathic medicines (including antibiotics, steroids and vitamins), although not qualified or authorized to do so. A survey of the private health sector in rural Maharashtra found that only 30 per cent of the sample were qualified allopaths, but 79 per cent were practising allopathy exclusively.

Several studies have linked unsafe injection practices in Indian health settings to the transmission of blood-borne pathogens, and others have highlighted unsafe injection practices in both formal and informal settings. Recently, a large World Bank-funded study, undertaken by the India CLEN Program Evaluation Network, estimated that 3-6 billion injections are provided in India each year, that almost two-thirds of these injections are unsafe, and 32 per cent have the potential to transmit blood-borne infections. Estimates of the average number of injections/person/year in India range from 2.4-5.8. Almost half of a community-based sample from New Delhi (46%) had received at least one therapeutic injection in the last three months.

A number of policy- and practice-based responses to the problem of unsafe injections have been initiated in India. The Indian Injection Safety Coalition, a national network of organizations that work together to promote safe and appropriate injection practices, was formed in 2002. The Indian Medical Association released a Policy on Safe Injections and the health ministry pledged to introduce auto-disable syringes into all immunization programmes in 2004. An international non-governmental organization (PATH) in partnership with a hospital in Hyderabad have developed a Model Injection Centre (MIC) that provides education and training with the aim of promoting injection safety.

We therefore carried out this study to determine the extent to which rural north Indian patients using formal health services also consult and receive injections in the informal traditional sector, quantify the injections received by these patients and their relatives, and assess the level of knowledge and attitudes in relation to injections.

Material & Methods

Study design: A cross-sectional survey of inpatients and their relatives was undertaken between November 2004 and February 2005. The data collection was done from two hospitals located in rural areas of the neighbouring States of Bihar and Jharkhand. Both study sites are administered by an Indian non-government organisation (NGO), the Emmanuel Hospital Association which has a commitment to the provision of health care for the rural poor. These two hospitals were selected as the study sites because they were two of the largest hospitals in rural north India administered by this particular NGO. The Bihar hospital had 200 bed capacity and provided services in surgery, medicine, ophthalmology, obstetrics & gynaecology, paediatrics, orthopaedics and dentistry and the hospital in Jharkhand had 100 bed capacity.
with services in surgery, ophthalmology and obstetrics & gynaecology.

We recruited 75 per cent of the sample from the larger Bihar hospital and 25 per cent from the smaller Jharkhand hospital. Additionally, we recruited approximately equal proportions of males and females and of younger (<35 yr) and older participants (>35 yr). This was important for the patient survey in particular, otherwise the sample would have consisted predominantly of young women as the majority of patients in both hospitals were obstetric patients.

**Patient sample and survey instrument:** A total of 280 inpatients were systematically sampled (210 from the Bihar hospital and 70 from the Jharkhand hospital). On the first day of the survey we approached every inpatient in each clinical area and returned each day thereafter to recruit new admissions until we reached our required sample (in relation to sex and age). We followed up those patients who were asleep or absent at the time of our first visit. Patients were not approached if they were very ill or disoriented. Those who could not speak Hindi, were aged ≤ one month, or had been admitted > one week previously were excluded. In the case of paediatric patients, the mother answered questions on behalf of her child. The sample size calculation was based on an anecdotal estimate that 50 per cent of patients hospitalized in the formal sector had previously consulted in the informal sector. A sample size of 267 was required for the 95 per cent confidence interval (CI) to be 50 per cent ± 6 percentage points.

The patient survey was brief and questions were asked about the number and type of consultations with healthcare practitioners and any injections received in the month preceding admission (how many, from whom, and where). The patients were also asked about the most recent injection received prior to the current admission (from whom, where, and with what type of needle and syringe). The classification of healthcare practitioners were: qualified medical doctor, nurse, dentist, community health worker, non-MBBS doctor and compounding. Non-MBBS doctors are those who do not have formal allopathic medical qualifications, although they may or may not have other qualifications in Indian systems of medicine (such as Ayurveda) or homeopathy. Compounders work in pharmacies but are not necessarily formally qualified to prescribe and dispense medications.

**Relative sample and survey instrument:** A total of 120 relatives of inpatients were convenience sampled for this survey (90 from the Bihar hospital and 30 from the Jharkhand hospital). Relatives were recruited until we had reached our required sample (in relation to sex and age). Only one relative per patient was surveyed. The relative survey asked about: injections received in the last three months (how many, from whom, and where); the most recent injection received (from whom, where and with what type of needle and syringe); and knowledge and understanding of the link between unsafe injections and disease transmission. Those who agreed that diseases can be spread by unsafe injections were asked to describe how they thought this was possible, which diseases/conditions are involved, and how it can be prevented.

Only the relative group were asked questions pertaining to injection-related knowledge and attitudes, as we wanted to minimize the number of questions asked of patients. Most of the questions for relatives elicited quantitative responses, but some were qualitative. Although not a representative sample, the injection-related knowledge and experiences of the relatives provides an indication of the situation in the general community.

**Data collection and analysis:** Both questionnaires were specially designed for the study, piloted in the field and administered in Hindi by one of the authors (VM). The participant’s responses were recorded on paper and subsequently entered into a database. The data were analysed using Statistical Package for the Social Sciences Version 11.5. The statistical tests used to assess the strength of association between variables included Chi-square and independent samples t-test.

This study was approved by the Human Research Ethics Committee of the University of Melbourne in June 2004. All potential participants were verbally informed about the purpose of the study; what was
required of them as participants; that the study was confidential; and that participation was voluntary. The interviewer signed a form for each participant indicating that she had conveyed all the relevant information and that the person had agreed to participate in the study. This approach was appropriate in a context of limited literacy.

Results

Demographic information: The maximum number of patients were from medical/surgical clinical areas (not obstetrics) because the patients from the general area were also medical/surgical combined (Table I). Slightly more than half (51%) were females and the average age was 34.5 yr (median 30 yr, range 1 month - 80 yr, standard deviation (SD) 19.6). Among the relative group (n = 120), 49 per cent were females and the average age was 37 yr (median 35 yr, range 17-70 yr, SD 12.2). Many of the women and some of the men did not know how old they were. In such cases the interviewer estimated their age. The number of patients and relatives refusing to participate was very small (no more than five in either site).

Consultations with healthcare practitioners and injections received by patients: Sixty one per cent of the patients (170/280) had consulted at least one healthcare practitioner in the month prior to admission. Having consulted a practitioner was not associated with age or study site but was associated with sex. Females were more likely to have consulted an injection (50.3 vs 35.0%, P<0.05), but this is probably attributable to the tetanus injections commonly given to obstetric patients antenatally (Table II).

Forty three per cent (120/280) of patients had received at least one injection in the month prior to admission. Having received an injection was not associated with age or study site but was associated with sex. Females were more likely to have received an injection (50.3 vs 35.0%, P<0.05), but this is probably attributable to the tetanus injections commonly given to obstetric patients antenatally (Table III).

The total number of injections given to this group of 280 patients in the month prior to admission was 315, and the average number was 1.13 (range 0-12, SD 1.76). However, the average number of injections among the 43 per cent who received injections was 2.63 (range 1-12, SD 1.82). The injections were most commonly administered by nurses, followed by non-MBBS doctors, qualified medical doctors, compounders and relatives (Table III).

About 40 per cent patients received the most recent injection in hospitals, followed by 26.5 per cent at home and 12.5 per cent from other sources (Table IV).

Table I. Clinical areas from where patients were recruited

<table>
<thead>
<tr>
<th>Clinical area</th>
<th>Bihar</th>
<th>Jharkhand</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetric</td>
<td>44</td>
<td>23</td>
<td>67</td>
</tr>
<tr>
<td>Surgical</td>
<td>55</td>
<td>-</td>
<td>55</td>
</tr>
<tr>
<td>Medical</td>
<td>54</td>
<td>-</td>
<td>54</td>
</tr>
<tr>
<td>General</td>
<td>-</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>Paediatric</td>
<td>34</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>23</td>
<td>-</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>210</td>
<td>70</td>
<td>280</td>
</tr>
</tbody>
</table>

*Medical and surgical combined

Table II. Consultation patterns among patients who consulted with a healthcare practitioner in the month prior to admission

<table>
<thead>
<tr>
<th>Qualified Doctor</th>
<th>Nurse</th>
<th>Non-MBBS Doctor</th>
<th>Compounder Doctor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of patients consulting</td>
<td>122 (72.0%)</td>
<td>2 (1.2%)</td>
<td>59 (34.5%)</td>
</tr>
<tr>
<td>with this practitioner* (n = 170)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of total consultations</td>
<td>204 (63.5%)</td>
<td>6 (1.9%)</td>
<td>92 (28.7%)</td>
</tr>
<tr>
<td>with this practitioner (n = 321)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Some patients consulted more than one type of practitioner; values in parentheses are percentages.
cent at home and 24.8 per cent in a doctor’s clinic (Table IV).

The majority of patients (72.0%, 85/118) said that the most recent injection was given using a new needle and syringe that they had witnessed being removed from a packet. One-fifth (24/118, 20.3%) did not see or could not remember what type of needle and syringe was used. Only 7.6 per cent (9/118) reported that the most recent injection was given using a nonsterile needle and syringe. Eight of these were given with metal reusable needles and glass syringes and one with a disposable needle and syringe removed directly from the practitioner’s bag (no packet).

**Injections received by relatives:** Among the relatives, 13.3 per cent (16/120) reported receiving at least one injection in the last three months. Having received an injection was not associated with age or sex but was associated with study site. Injections were more common in Jharkhand compared to Bihar (26.7 vs 8.9%, \(P<0.05\)).

The total number of injections given in the last three months was 42, and the average number was 0.35 (range 0-8, 1.17). The average in Jharkhand was 0.93 (95% CI 0.18-1.69) and in Bihar was 0.16 (95% CI 0.03-0.28) (\(P<0.05\)). However, the average number of injections among those who received injections was overall 2.63 (range 1-8, SD 2.12), but was 3.50 (95% CI 1.36-5.64) in Jharkhand and 1.75 (95% CI 0.78-2.72) in Bihar. Injections were most commonly administered by non-MBBS doctors, followed by nurses, relatives, qualified medical doctors, compounders and community health workers (Table V).

Most of the most recent injections received were administered in the relative’s own home (n=7); four were given in a clinic setting, three in hospitals and one in a pharmacy. The majority (13/15) reported that the most recent injection was given using a new needle and syringe that they had witnessed being removed from the packet. The other two either did not see or did not remember what type of needle and syringe had been used.

### Table III. Injection patterns among patients who received at least one injection in the month prior to admission

<table>
<thead>
<tr>
<th>Place of injection</th>
<th>Qualified Dr (n=16)</th>
<th>Nurse (n=38)</th>
<th>Non-MBBS Dr (n=36)</th>
<th>Compounder (n=9)</th>
<th>Relative (n=1)</th>
<th>Total (n=117)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>9 (7.7)</td>
<td>38 (32.5)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>47 (40.2)</td>
</tr>
<tr>
<td>Doctor’s clinic</td>
<td>6 (5.1)</td>
<td>16 (13.7)</td>
<td>3 (2.6)</td>
<td>4 (3.4)</td>
<td>-</td>
<td>29 (24.8)</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3 (2.6)</td>
<td>-</td>
<td>3 (2.6)</td>
</tr>
<tr>
<td>Patient’s home</td>
<td>-</td>
<td>1 (0.8)</td>
<td>27 (23.0)</td>
<td>2 (1.7)</td>
<td>1 (0.8)</td>
<td>31 (26.5)</td>
</tr>
<tr>
<td>Healthcare provider’s home</td>
<td>1 (0.8)</td>
<td>-</td>
<td>5 (4.3)</td>
<td>-</td>
<td>-</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td>Relative’s home</td>
<td>-</td>
<td>-</td>
<td>1 (0.8)</td>
<td>-</td>
<td>-</td>
<td>1 (0.8)</td>
</tr>
</tbody>
</table>

*Some patients received injections from more than one type of practitioner; Values in parentheses are percentages.*
Injection-related knowledge and attitudes: More than two-thirds of the relatives (68.6%, 81/118) preferred oral medication if they had a fever. Only 9.3 per cent preferred an injection. The others preferred to follow doctor’s orders (9.3%), use other forms of treatment (6.8%), or have no treatment (5.9%). Those who preferred oral medication did so because of the perceived positive attributes of oral medication (easy to take, provides effective relief, cheaper and more readily available than injections) and/or because of the perceived negative attributes of injections (pain, drug reactions & possible use of unsterile injecting equipment). The reason for preferring injections was overwhelmingly because of the belief that they provide more rapid relief.

The majority of relatives (70.8%, 85/120) knew that it was possible to spread diseases via unsafe injections. Knowing that unsafe injections can spread diseases was not associated with site but was associated with both sex and age. Males were much more likely than females to have this knowledge (86.9 vs 54.2%, P<0.001), as were those aged < 35 yr compared to those aged ≥ 35 yr (80.7 vs 61.9%, P<0.05).

The vast majority (56/85, 65.9%) of those who agreed that diseases could be spread by unsafe injections identified the use of needles and syringes for more than one person as the mechanism for disease transmission. Others said that disease spread was due to the use of unclean needles and syringes (which may or may not mean reuse). Another common response to this question was ‘through blood’. A small number were unable to explain how unsafe injections spread disease.

When asked about the type of diseases/conditions associated with unsafe injections, 56.0 per cent mentioned HIV/AIDS, 10.6 per cent hepatitis and 2.4 per cent abscesses. Almost half (48.2%) also mentioned a range of other conditions including tuberculosis, malaria, cancer, leprosy, diabetes, asthma, tetanus, pneumonia and fever, most of which are not transmitted by unsafe injections. One-quarter (23.8%) of those who knew that diseases could be spread by unsafe injections were unable to name any.

Relatives who knew about the link between unsafe injections and disease were asked an open-ended question regarding possible strategies for addressing the problem. The vast majority (65/85, 76.5%) said that needles and syringes should be used once only and/or that only new/sterile/disposable needles and syringes should be used. A smaller number (6/85, 7%) suggested washing/cleaning/heating/boiling needles and syringes before use, which is unlikely to be a safe solution. A few others suggested that tablets should be taken in place of injections.

Discussion

The findings of this survey among patients and relatives in two rural north Indian hospitals showed that consultations with healthcare practitioners from the informal sector were commonplace; injections were frequently provided by informal practitioners; many injections were being administered in a home setting (mainly by informal practitioners); most injections were given using a new needle and syringe; only a small proportion of people preferred injections

<table>
<thead>
<tr>
<th>Table V. Injection practitioners and patterns among relatives who received at least one injection in the last three months</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proportion of relatives receiving at least one injection from this practitioner</strong></td>
</tr>
<tr>
<td>(n = 16)</td>
</tr>
<tr>
<td><em>Some relatives received injections from more than one type of practitioner; CHW, community health worker</em></td>
</tr>
<tr>
<td>Values in parentheses are percentages</td>
</tr>
<tr>
<td><strong>Proportion of total injections given by this practitioner</strong></td>
</tr>
<tr>
<td><strong>(n = 42)</strong></td>
</tr>
</tbody>
</table>
to oral medication; and awareness of the association between unsafe injections and disease transmission was overall quite good (but less so among women).

If qualified medical doctors and nurses are classified as formal healthcare practitioners, and non-MBBS doctors and compounders are classified as informal healthcare practitioners, then 39 per cent of the patients who consulted a healthcare practitioner in the month prior to admission did so at least once in the informal sector. This is a relatively large proportion considering that the participants were inpatients in a formal health care setting at the time they were surveyed.

Only 13 per cent of the relative group had received an injection in the last three months, which is considerably less that the 46 per cent reported among a community sample in New Delhi. However, it is probable that patterns of injection use vary between urban and rural areas, just as there was a difference between the two study sites. Similarly, the average number of injections/person/year in this sample was 1.4 overall, which is less than the 2.4-5.8 reported in other Indian studies. Once again, this may be attributable to geographical variation as the average number of annual injections for the relatives in Jharkhand (excluding those from Bihar) was 3.7, which is similar to the number reported in previous studies.

Almost one-third of the injections received by patients and 46 per cent of injections received by relatives were administered in the home mostly by practitioners from the informal sector, yet little is known about the safety of injections in this setting. More research is needed to improve knowledge and understanding about injections provided in home settings.

The majority of participants reported that the most recent injections were administered with a new needle and syringe, which is not consistent with the findings of other Indian studies. This may indeed reflect a trend towards improved practices, or it may be due to the fact that other studies have relied on more rigorous methods such as observing practitioners administering injections rather than reports from injection recipients.

It does not appear that overvaluing of injections by community members is contributing substantially to the possible overuse of injections, as only 9 per cent preferred injections for treatment of fever, which is slightly less than the 14 per cent preferring injections in the Delhi-based study, and the 18 per cent in a village-based study in Haryana. This finding challenges the often held belief of injection providers that patients prefer injections, which they sometimes use as a rationale for providing them.

Seventy one per cent of relatives (only 54% of women) were aware of the link between unsafe injections and disease transmission, but discrepancies between women and men, and younger and older participants were observed. This represents a higher level of awareness than that found in a rural area of Haryana where only 45 per cent knew that diseases could be spread by unsafe injection practices. Strategies for communicating HIV/AIDS prevention and injection safety messages to poor rural women with limited literacy need to be considered.

This study has a number of limitations. Even though the patients were systematically sampled, they were not representative of the community generally or patients in particular. The fact that they were recruited from the formal health sector is biased against those who prefer the informal sector or use it exclusively. It is also possible that these findings represent an underestimate of the proportion of patients using informal sector services, as some may have been unwilling to admit to this whilst in-patients in a formal sector service. Another factor that potentially contributes to an underestimate of the proportion using the informal sector is the possibility that some participants may not have been able to distinguish between qualified medical doctors and non-MBBS ‘doctors’, and consequently (mis)classified non-MBBS doctors as qualified medical doctors.

In conclusion, our findings highlight the popularity of healthcare providers from the informal sector and the fact that a significant proportion of injectable medications are being provided by practitioners who are not qualified to prescribe or administer them. Even though the participants in this
study reported the use of new disposable injection equipment as commonplace, the high proportion of injections given by informal practitioners necessitates that strategies to enhance injection safety in India must actively engage and target practitioners from both the informal and formal sectors.

Acknowledgment

Authors thank Drs B. Langkham and Mathew Santhosh Thomas (Emmanuel Hospital Association, New Delhi, India), for facilitating access to the two study sites; and Prof. Nick Crofts (Turning Point, Melbourne, Australia) for providing advice regarding the study design.

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