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# Injection use in two districts of Pakistan: implications for disease prevention

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## Abstract

**Objective.** To estimate the annual number of injections per person in Sindh province of Pakistan and to describe their distribution with regard to prescribers, settings, and safety.

**Design.** A population-based cross-sectional study in July–September 2001.

**Setting.** Lyari, an urban town in Karachi district; and Digri, a rural subdistrict in Mirpur Khas district.

**Study participants.** We selected a population-based cluster sample of 1150 individuals aged ≥3 months. We interviewed one person per household for the number of encounters they had with health care providers, number and types of injections received, safety circumstances, and cost of injections during the past 3 months.

**Main outcome measure.** The number of injections per person per year.

**Results.** After adjusting for age and sex, 68% of participants had received at least one injection in the previous 3 months (13.6 injections/person/year). The majority of the respondents received injections at the clinics of qualified general practitioners ($n$ = 571, 67%) by dispensers (644, 76%). Most of the injections ($n$ = 3446, 96%) were for curative purposes. A freshly opened syringe was used for only 454 (53%) of the injections. The average fee for receiving an injection was Rs. 51 (US$0.8).

**Conclusion.** Injections are overused in Pakistan's Sindh province and the ratios of injection per capita that we found are among the highest ever reported. Interventions are needed to substantially reduce injection prescription among private health care providers who prescribe most of the injections received by the population.

**Keywords:** blood-borne pathogens, cluster analysis, equipment reuse, health care providers, health care surveys, injection practices, Pakistan

Injections are the most frequent medical procedure performed throughout the world. An estimated 16 billion injections are administered each year in developing and transitional countries [1]. Various levels of injection use have been reported worldwide ranging from 1.7 in Brazil to 13 injections per person per year in Mongolia [1,2].

Many injections in developing and transitional countries are given with injection equipment that has been reused in the absence of sterilization [1]. Reuse of injection equipment transmits hepatitis B virus (HBV) [3,4], hepatitis C virus (HCV) [5], HIV [6], and many other pathogens such as viral haemorrhagic fever viruses [7,8]. As the number of injections increases, the probability of exposure to infectious agents also increases [9]. Interventions that reduce the frequency of injection should therefore reduce transmission and save costs associated with injection equipment, injectables, and out-of-pocket providers' fees. These interventions to decrease injection use could be more successful if information were available regarding injection use, distribution of injections with regard to prescribers, providers, and determinants of injection use.

Several reports suggest that injections are overused in Pakistan [10–12]. Reuse of single-use injection equipment is also common [11]. However, no population-based estimates of injection frequency were available. Furthermore, no information was available with respect to the distribution of injections according to prescribers (e.g. MBBS) and injection providers (e.g. nurses). To address these, we conducted a survey to estimate the annual ratio of injection per capita in Sindh province, Pakistan, to describe the distribution of injections with respect to prescribers, injection providers, types of injection and health care facility, and to estimate the proportion of unsafe injections. We used WHO standardized methodology to generate estimates of injection use so that they could be compared with those reported in other countries [13].

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## Materials and methods

### Study setting

We conducted a population-based cross-sectional survey from July to September 2001 in an urban and a rural setting in Pakistan's Sindh province. We selected Lyari, an urban town in Karachi (Pakistan's largest city) with an ethnically diverse population including Baloch, Punjabi, Mohajir, Pakhtoon, and Sindhi. Lyari has a population of more than 600 000 people with an average household size of 6.5 persons and a literacy rate of 67% [14]. Public health care facilities, general practitioners (GPs) and private unqualified practitioners provide health care. In contrast, Digri is a rural area in Mirpurkhas district. It is located about 300 kilometres from Karachi and comprises 294 000 people of Sindhi, Punjabi, and Balochi descent living in scattered small villages. Its literacy rate is lower than Lyari and agriculture is the primary source of income [14]. People seek health care from few qualified physicians at state-run Basic Health Units, private unqualified practitioners, and GPs. These two settings were selected conveniently as these house all the major ethnic groups (Punjabi, Mohajir, Pakhtoon, Sindhi, and Baloch) of Pakistan and hence the findings from the study may apply to the areas of this population origin.

### Design

We defined the survey population as individuals aged at least 3 months and residing for at least 3 months in the selected localities. We used a cluster-sampling technique to select study subjects. We defined a cluster as a group of people living within specific administrative boundaries. These clearly demarcated areas are called 'sector' in Lyari, and 'deh' in Digri. We selected a total of 34 clusters: 17 clusters each from 133 available clusters in the rural area and 104 available clusters in the urban area based on probability proportional to size. Average number of houses in a cluster was 280 in the rural area and 650 in the urban area. People living together and sharing the same kitchen were considered as living in the same household [15]. We used the households as sampling units and individuals selected randomly from within households as sampling elements. Within each cluster, we selected 35 households using systematic sampling following the right-hand rule with a random start from a central point and then selected one person from each household using the lottery method [15].

Trained interviewers fluent in the respondents' primary language interviewed participants or guardians of children <15 years of age to collect information on encounters with health care providers, ailment complaints, injection prescribers, injection providers, types of injection, safety circumstances, and cost of injections that were received during the 3 months preceding the interview. Injection was defined as a procedure that pierces the skin or a mucosal membrane to introduce a substance into the body. These injections included those administered for immunization, therapeutic (injections and infusions), or diagnostic purposes [16]. We defined a physician as a person with basic medical qualifications (MBBS) and physicians working in the private sector as GPs. We defined a dispenser as a person who dispenses medicine and provides the injection. Practitioners with no basic medical qualifications (MBBS) were considered 'unqualified practitioners'. These practitioners work independently and illegally at their clinics, prescribe and dispense medicine, and administer injections.

We based sample size calculations on assumptions that 67% of the population received at least one injection during the past year with 95% confidence level and 3% precision [5,11]. After allowance for a design effect of 1.68 and 10% non-response over the initial sample size of 621, we planned for 1149 study subjects [15].

The Ethics Review Committee of Aga Khan University, Pakistan approved the protocol. We explained the purpose of the study to the subjects and obtained verbal informed consent.

### Statistical analysis

We double entered data in Epi Info software version 6.04 and analysed it in Epi Info and Statistical Package for Social Sciences (SPSS) version 10.0. We estimated annual ratios of injections per capita and proportions of those who had received at least one injection and adjusted these estimates for the age and sex distribution of the population in the area as standard obtained from the National Population Census, 1998 [14]. We obtained the annual ratio of injections per capita by multiplying the average number of injections received during 3 months by four. We calculated the overall cost of an injection to patients by subtracting the reported cost of visits during which no injection was administered from the cost of visit during which an injection was administered (the injection was paid for as part of the health care visit). We performed cluster analysis to account for clustering of injection practices at primary sampling unit level. We computed intraclass correlation coefficients and design effects and adjusted confidence interval and hypothesis testing for design effect [17].

## Results

We recruited 575 subjects in the urban and 575 in the rural setting (total: 1150). In the urban and rural areas, eight and five persons, respectively, refused to participate. We recruited replacements from adjacent households. The mean age of the study subjects was 25 years (SD: 18, median: 27 and range: 0.25–99 years); 873 (76%) were female. The proportion of study subjects who had no formal schooling was 56% ($n = 321$) and 75% ($n = 424$) in the urban and rural areas, respectively. The major ethnic groups were Sindhi [60% ($n = 343$)] in rural and Baloch [45% ($n = 259$)] in the urban setting. The median monthly family income was Rs. 4000 (US$63, mean: Rs. 4825, SD: Rs. 3538). Primary complaints on presentation to the health care provider during the last visit included fever (32%), body aches (13%), cough, flu, and sore throat (10%, Table 1).

**Table 1** Selected socio-demographic characteristics of the participants in injection use study in rural and urban settings of Sindh province, Pakistan 2001

| Variables | Urban | | Rural | | Total | |
|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % |
| Sex | | | | | | |
| Female | 441 | 77 | 432 | 75 | 873 | 76 |
| Male | 134 | 23 | 143 | 25 | 277 | 24 |
| Age in years[1] | | | | | | |
| 0.25–5 | 116 | 20 | 79 | 14 | 195 | 17 |
| 6–14 | 65 | 11 | 34 | 6 | 99 | 9 |
| 15–45 | 331 | 58 | 361 | 63 | 692 | 60 |
| >45 | 63 | 11 | 101 | 17 | 164 | 14 |
| Education (years of schooling)[1] | | | | | | |
| 0 | 321 | 56 | 424 | 74 | 745 | 65 |
| 1–5 | 119 | 23 | 64 | 11 | 183 | 16 |
| 6–10 | 104 | 18 | 59 | 10 | 163 | 14 |
| >10 | 31 | 5 | 28 | 5 | 59 | 5 |
| Ethnicity | | | | | | |
| Sindhi | 37 | 6 | 343 | 60 | 380 | 33 |
| Punjabi | 130 | 21 | 203 | 35 | 333 | 29 |
| Baloch | 259 | 45 | 1 | 0 | 260 | 23 |
| Mohajir[2] | 94 | 16 | 26 | 5 | 120 | 10 |
| Pukhtoon | 55 | 10 | 2 | 0 | 57 | 5 |
| Family income[3] | | | | | | |
| <1500 | 29 | 5 | 133 | 23 | 162 | 14 |
| 1501–2500 | 59 | 10 | 88 | 15 | 147 | 13 |
| 2501–4000 | 223 | 39 | 119 | 21 | 342 | 30 |
| 4001–6000 | 153 | 27 | 88 | 15 | 241 | 21 |
| >6000 | 110 | 19 | 146 | 26 | 256 | 22 |
| Presenting complaint[4] | | | | | | |
| Fever | 124 | 25 | 185 | 39 | 309 | 32 |
| Body aches | 85 | 17 | 38 | 8 | 123 | 13 |
| Cough/sore throat | 66 | 14 | 30 | 6 | 96 | 10 |
| Gastrointestinal problem | 40 | 8 | 36 | 8 | 76 | 8 |
| Vaccination | 4 | 1 | 66 | 14 | 70 | 7 |
| Diarrhoea | 43 | 9 | 18 | 4 | 61 | 6 |
| Cardiovascular disease | 36 | 7 | 14 | 3 | 50 | 5 |
| Weakness | 17 | 4 | 18 | 4 | 35 | 4 |
| Gynaecological problem | 19 | 4 | 13 | 3 | 32 | 3 |
| Respiratory illness | 21 | 4 | 10 | 2 | 31 | 3 |
| Skin problem | 11 | 2 | 19 | 4 | 30 | 3 |
| Other | 8 | 2 | 16 | 3 | 24 | 3 |
| Renal colic | 12 | 2 | 4 | 1 | 16 | 2 |
| Surgery | 6 | 1 | 7 | 1 | 13 | 1 |

[1]Data collected as continuous variable and categorized later.
[2]Includes these who originated from parts of India not presently included in Pakistan.
[3]Income in Pakistani rupee, Rs. 65 = US$1 at the time of study.
[4]Complaints from the last visit only: complaints from the same system merged for ease of presentation.

## Injection frequency

In this sample 968 (84%) participants reported contact with a health care provider during the previous 3 months. After adjusting for age and sex, 68% (95% CI: 66–69%) of all subjects ($n$ = 1150) received at least one injection. The proportion of those who reported receiving an injection was slightly higher among those under 5 years of age (79%) than among older age groups (60–76%, Table 2).

**Table 2** Proportion of subjects who received at least one injection during the previous 3 months by age group, Sindh province, Pakistan 2001

| | Urban ($n$ = 575) | | Rural ($n$ = 575) | | Overall ($n$ = 1150) | |
|---|---|---|---|---|---|---|
| | $n$ | % | $n$ | % | $n$ | % |
| Age in years | | | | | | |
| 0.25–5 | 116 | 74 | 79 | 100 | 195 | 79 |
| 6–14 | 65 | 74 | 34 | 84 | 99 | 76 |
| 15–45 | 331 | 57 | 361 | 77 | 692 | 60 |
| >45 | 63 | 72 | 101 | 63 | 164 | 71 |
| Total | 575 | 65 | 575 | 81 | 1150 | 68 |

The crude ratio of injections per capita per year was 11.4 (median: 8, SD: 28, range: 0–372). The ratio standardized for age and sex was 13.6 injections/person/year (Table 3). When we excluded the upper 2% of frequency distribution (all those receiving >60 injections per year) the age and sex standardized annual ratio of injection per capita in urban strata, rural strata and overall was 8.3, 7.3, and 8.2, respectively. In comparison with rural area residents, fewer urban area residents reported receiving an injection (81% versus 65%, $P < 0.001$). However, when the mean number of injections was considered, urban area residents reported receiving more injections per capita than rural residents (14.6 versus 7.8, $P = 0.004$). This difference was accounted for by a higher number of injections per prescription in the urban area as well as a higher mean number of visits to health care providers during the previous 3 months (2.2 versus 1.2). Injection frequency also differed significantly between ethnic groups (F-test = 7.7: $P < 0.001$: data not shown). Baloch tribe people reported receiving the highest (19.7 injections per person per year) number of injections. The frequency of injection did not differ between male and female (11.9 versus 11.3 per year: $P = 0.737$). Most of those who presented for fever received injections ($n$ = 279/309: 90%) and a slightly smaller proportion of those with other complaints also received injections ($n$ = 567/657: 87%); the difference was not significant ($P = 0.079$). This suggests that injections are provided regardless of the presenting complaint and hence a large proportion of these injections such as those provided for fever, flu, etc. might not be necessary.

## Types of injections

Of the 3585 injections administered during the previous 3 months, 96% were for therapeutic purposes (Table 4). The proportion of injections administered for vaccination was higher in the rural area (8%) than in the urban area (2%, $P < 0.001$).

**Table 3** Annual ratio of injections per capita by age groups in Sindh province, Pakistan 2001[1]

| | Urban | | | Rural | | | Overall | | |
|---|---|---|---|---|---|---|---|---|---|
| | $n$ | Mean | 95% CI | $n$ | Mean | 95% CI | $n$ | Mean | 95% CI |
| Age: crude (years) | | | | | | | | | |
| 0.25–5 | 116 | 15.0 | 5.7–24.4 | 79 | 8.4 | 6.7–10.1 | 195 | 12.4 | 6.7–18.0 |
| 6–14 | 65 | 21.8 | 0.6–43.0 | 34 | 6.4 | 3.8–8.9 | 99 | 16.5 | 2.4–30.5 |
| 15–45 | 331 | 11.4 | 7.6–15.2 | 361 | 8.3 | 6.9–9.7 | 692 | 9.8 | 7.8–11.7 |
| >45 | 63 | 23.9 | 3.3–44.5 | 101 | 8.2 | 4.7–11.7 | 164 | 14.2 | 5.9–22.6 |
| Total | 575 | 14.7 | 10.3–19.1 | 575 | 8.2 | 7.1–9.3 | 1150 | 11.4 | 9.2–13.7 |
| Age and sex standardized | | | | | | | | | |
| 0.25–5 | 116 | 15.2 | 6.9–23.5 | 79 | 8.4 | 6.8–10.1 | 195 | 13.9 | 6.9–20.9 |
| 6–14 | 65 | 21.6 | 1.3–41.9 | 34 | 6.3 | 4.1–8.5 | 99 | 19.0 | 1.8–36.1 |
| 15–45 | 331 | 9.8 | 5.9–13.6 | 361 | 7.8 | 6.3–9.3 | 692 | 9.5 | 6.0–13.1 |
| >45 | 63 | 18.8 | 5.1–32.6 | 101 | 10.0 | 4.2–15.8 | 164 | 17.7 | 5.0–30.4 |
| Total | 575 | 14.6 | 4.8–24.3 | 575 | 7.8 | 5.5–10.0 | 1150 | 13.6 | 4.9–22.2 |

95% CI: 95% confidence interval.
[1]Clustering of outcome allowed in estimation of confidence interval.

**Table 4** Type of injections during previous 3 months in Sindh province, Pakistan 2001

| Injection type | Urban ($n$ = 2378)% | Rural ($n$ = 1207)% | Overall ($n$ = 3585)% |
|---|---|---|---|
| Therapeutic injection | 95 | 88 | 92 |
| Infusion | 3 | 4 | 4 |
| Vaccination | 2 | 8 | 4 |

### Injection prescribers and providers

GPs prescribed the majority of the injections received in the urban [297 (75%)] and in the rural [238 (53%)] areas during last visit. Dispensers were major providers of injections ($n$ = 644, 76%). GPs' clinics were the major setting ($n$ = 571, 67%) in which injections were provided. The private sector provided a higher proportion of the injections in the urban than in the rural area (91% versus 68%, $P < 0.001$). None of the injections were provided by the patient him/herself, a dentist, or a family member (Table 5).

### Safety of injections

During the last contact with the provider, a new syringe, defined as one opened in front of the patient was used for 191 (48%) and 263 (59%) injections in the urban and the rural area, respectively. Overall, 454 (54%) of the patients had been injected with freshly opened injection equipment (Table 6). Of 82 vaccination injections during the last visit, 67 (82%) were provided with a freshly opened syringe. In comparison with providers at public facilities ($n$ = 43/163, 26.4%), unqualified practitioner ($n$ = 244/508, 48%: OR = 5.2: 95% CI: 2.7–9.8) and GP ($n$ = 87/135, 64.1%: OR = 2.5: 95% CI: 1.5–4.6) prescribed injections were more likely to have been administered with a syringe of uncertain safety.

### Cost of injections

The overall cost of an encounter with a health care provider was Rs. 83 (US$1.3). This overall cost was Rs. 95 (US$1.5) when an injection was prescribed and administered and Rs. 44 (US$0.7) without injection. The mean and median differences between these two fees, Rs. 51 (US$0.8), Rs. 15 (US$0.2) were significant ($P < 0.001$, Mann–Whitney $U$ test).

## Discussion

Our findings indicate that the frequency of injection in Sindh province is one of the highest in the world [2,18]. Injection use occurred mainly in the private sector where they are prescribed by GPs and provided by unqualified dispensers. In addition to being overused, injections are also unsafe. For

**Table 5** Injection prescriber, provider, and setting for last injection received in Sindh province, Pakistan 2001

| Variables | Urban ($n$ = 395)% | Rural ($n$ = 453)% | Total ($n$ = 848)% |
|---|---|---|---|
| Type of prescriber at last visit | | | |
| Physician in private facility | 75 | 53 | 63 |
| Nurse in public facility | 0 | 21 | 12 |
| Unqualified practitioner | 14 | 18 | 16 |
| Physician in public facility | 10 | 8 | 9 |
| Hakeem/homeopath[1] | 1 | 0 | 0 |
| Chemist | 0 | 0 | 0 |
| Bone setter[2] | 0 | 0 | 0 |
| Injection provider at last visit | | | |
| Dispenser | 73 | 78 | 76 |
| Physician | 21 | 8 | 14 |
| Unqualified practitioner[3] | 6 | 14 | 10 |
| Hakeem/homeopath[1] | 0 | 0 | 0 |
| Setting for last injection | | | |
| GP clinic | 89 | 54 | 67 |
| Public dispensary/basic health unit | 5 | 26 | 16 |
| Unqualified practitioner's clinic[3] | 1 | 13 | 9 |
| Public hospital | 4 | 1 | 3 |
| Private hospital | 2 | 2 | 2 |
| Home | 0 | 4 | 2 |
| Traditional healer clinic | 0 | 0 | 0 |

[1]A hakeem is a person who practises traditional medicine.
[2]Bone setters in the rural area, called 'Phelwan'; some of them even have clinics.
[3]Practitioners having no basic medical degree such as MBBS.

**Table 6** Safety circumstances of last injection received in Sindh Province, Pakistan 2001

| Safety circumstances | Urban ($n$ = 395)% | Rural ($n$ = 453)% | Total ($n$ = 848)% |
|---|---|---|---|
| Source of syringe | | | |
| Newly opened, from the packet[1] | 36 | 43 | 39 |
| Newly opened brought by patient[1] | 13 | 15 | 14 |
| Behind the counter | 15 | 21 | 18 |
| Pot of water for boiling instruments[2] | 28 | 0 | 13 |
| Don't know | 7 | 15 | 11 |
| Pot of tepid water | 1 | 2 | 2 |
| Picked from the table/tray | 1 | 2 | 1 |
| Syringe used on previous patient | 0 | 2 | 1 |
| Changed needle | 1 | 0 | 1 |

[1]A syringe taken from a new packet whether provided at the clinic or brought by the patient in a closed packet was considered sterile.
[2]Water in the pot may not be boiling.

only about half of injections that patient could recall had a new freshly open syringe been used. This high number of injections increases the risk of exposure to blood-borne pathogens [9]. Thus, decreasing unnecessary injections is an important component of any strategy to interrupt the transmission of blood-borne pathogens in Pakistan, which is facing an epidemic of hepatitis B and C [19].

Injection overuse has also been reported from other countries. The highest frequencies of injections per person has been reported from Romania, Moldova, and Mongolia, with 5.3, 12.4, and 13 injections per person per year [2,18,20]. In these countries, injections are used in a formal public health care setting, where they are prescribed by physicians and administered by nurses. Outdated treatment protocols often drive injection use in these countries, which used to follow the biomedical model of the former Soviet Union. In Africa, nurses prescribe and provide injections in the public sector. In Uganda, nurses administer the majority of the 5.3 injections that on average each person receives each year [21]. In Africa outdated treatment guidelines and financial incentive are key determinants of injection use. The introduction of revised treatment protocols reduced injection use in Tanzania [22]. In the state of Haryana, India, each person receives 2.5 injections each year. Injections are prescribed by GPs and unqualified practitioners in the private setting [23]. However, preliminary results of a nationwide assessment of injection use suggest that these values are underestimated (N. K. Arora, personal communication). Injections are overused because of economic incentives [24]. Injections in Pakistan are prescribed predominantly at GP clinics, where dispensers administer them. Injection administration is not driven by the old treatment protocols (treatment protocols are not present or prescribers are unqualified). Rather, economic incentives and perception about patient preference for injection are key drivers. Economic incentives play a key role: there is a difference in cost of the visit for which injection is included and the cost of a visit for which injection is not included. In addition, the health care provider earns more when he reuses the syringe for patients. Thus, efforts to decrease injection use should address economic incentives for health care providers, especially for GPs and unqualified practitioners.

In Romania, Moldova, and Mongolia, an increase in the supply of single-use injection equipment in the last 10 years has reduced the reuse of injection equipment because it was insufficient supply of injection equipment that drove reuse[25]. Revision of treatment and sterilization guidelines has been found to reduce injection use and improve sterility in Tanzania [22]. In Pakistan, increasing injection equipment supply may not have a major effect on reuse in the private sector, as single-use syringes are already available in the market at tha low price of Rs. 2 (US$0.03). Thus, a number of other factors may explain unsafe injection practices including poor regulation of malpractice, economic incentives, lack of awareness in the population, and poor consumer protection [26,27]. In this situation, injection devices with reuse prevention features including auto-disable syringes, may improve safety. Other factors that could be beneficial include consumer empowerment through education to question the rationality of injection prescription and the safety of the syringe.

Injection practices in Pakistan are more similar to those in other countries in South-East Asia, and in the eastern Mediterranean region. In Egypt, India, Nepal, Thailand, and Indonesia injection use is also high. Most injections are administered in the informal or the private sector and reuse is common [1,23,28–30]. The predominant use of health care from private and informal providers in these countries may explain the injection practices similar to those observed in Pakistan. Thus, attempts to improve injection safety must give priority to the private sector in Pakistan and other countries of the region with similar practices. Since the private sector is not under the direct control of the government, their practices may not have been regulated previously. Thus, more efforts and programmes are needed to engage private providers in a dialogue on injection safety.

Our population sample included people who have been hospitalized or are also diabetics. These individuals received many injections. The distribution of injection frequency is skewed towards the right in our sample, estimates without

excluding upper 2% were 13.6 and after removal were 8.2. This distribution of injections has important implications. Firstly, in planning injection equipment supply needs, if estimates include few high injection users, they will falsely overestimate the injection equipment required at provincial or national level. Secondly, these estimates should not be used crudely in the mass action model for estimating transmission the risk of blood-borne pathogens to the general population as a high proportion of injections are clustered in a small proportion of the population [9].

Our study had the following limitations. Firstly, in our study sample the males in the age group 15–45 years and school-age children were under-represented because we were able to visit a household only once and these population groups were not present at home during the day. To address the selection bias we obtained age and sex standardized estimates for injection frequency. Secondly, the cost of an injection cannot be measured accurately in population surveys, as it is aggregated in a single fee that includes the consultation fee, drugs, and injections. While we tried to address this limitation by comparing the cost of visits with injections and without injections, facility surveys are a more appropriate method to estimate the components of the cost of an injection more accurately. Thirdly, the annual ratio of injections obtained by extrapolation of 3 month recall may slightly overestimate immunization injections over the year as well as overall estimates, since immunization injections may have been received once or twice during the study period. Although this may not have major effect on overall estimates, the findings should be used with caution. Fourthly, the two communities are not a strictly statistically representative sample from Sindh province or Pakistan.

Injections are overused in Sindh province of Pakistan to administer medication and the number of injections per capita that we found is among the highest ever reported. Such a high frequency of injections needs the attention of the policymakers. The private sector, especially GPs, is a major contributor to this injection overuse. Thus, that sector should be the key target of interventions to reduce injection frequency. Interventions that address providers' economic incentives may contribute more to reducing injection frequency. In addition, interventions are needed to improve the safety of injections. These include the introduction of injection devices that prevent reuse, behavioural modification of providers, increasing awareness in the population of risks associated with injection, creating consumer avoidance of injections and demand for safety. The introduction of auto-disable devices may engage providers in safer injection practices. Interventions that can be easily translated and integrated into an already existing programme may be more promising in reducing injection overuse. Further research is needed to assess how many of the injections administered are unnecessary and hence could be avoided.

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