# Reducing injection overuse through consumers'–prescribers' interactional group discussions in Dar es Salaam region, Tanzania

**Aims:** This study aimed to assess the efficacy of an innovative behavioral intervention, interactional group discussions (IGDs), for reducing the overuse of injections. **Materials & methods:** This study involved ten public (randomized into five control and five intervention groups) and ten private (randomized into five control and five intervention groups) dispensaries. Prescribers in the intervention group were each invited to one IGD, which consisted of six prescribers and six consumers (of whom the majority were mothers with sick children under 5 years of age); a total of five IGDs were held in a 4-week period. All invited prescribers participated. Outcome measures were assessed in relation to a pre- and post-change using STATISTICA to analyze quantitative data, whereas qualitative data were analyzed using socioanthropological approaches. In control public dispensaries, the percentage of prescriptions that were for injections was 32% at baseline, compared with 31% in the intervention groups. **Results:** Using time series in the intervention facilities, the rate of injections prescribed fell from 31% at baseline to 22% 3 months post-IGDs ($p < 0.05$). In the private control dispensaries the rate of injection use was not significantly different (43 and 47%, respectively; $p > 0.05$). In the control dispensaries, there was a significant drop in the rate of injection use from 43% at baseline to 38% 3 months post-IGD ($p < 0.05$). This rose significantly to 49% 9 months post-IGD ($p < 0.05$). In the control facilities, the percentage of appropriate prescriptions of injections fell from 15% at baseline to 11% 3 months post-IGD, and rose to 16% 9 months post-IGD. Furthermore, the rate of injection use in the intervention group fell significantly from 44% at baseline to 35% 3 months post-IGD. This rose to 37% 9 months post-IGD. In addition, there were changes in the prescription of generic drugs, but no changes in injection use or prescriptions. **Conclusion:** The IGDs significantly reduced the overuse of injections, but the reduction was not sustained as prescriptions of injections soon returned to the original numbers. There was an overall reduction in the prescription of injections 3 months after intervention. However, injection use did not improve 9 months post-IGD, indicating that the prescribers did not practice what they had learnt. To sustain this practice, periodic training, monitoring and supervision are required in these facilities on a regular basis.

**KEYWORDS: focus group discussion ▪ injection ▪ interactional group discussion ▪ malaria ▪ prescriber ▪ primary healthcare ▪ public and private facility ▪ standard treatment guidelines**

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Irrational prescribing, in many forms, is commonly seen in various healthcare facilities in developing countries such as Tanzania. A study conducted by the International Network for Rational Use of Drugs (INRUD) in Tanzania between 1999 and 2001, in public and church-owned primary healthcare (PHC) facilities, found frequent irrational use of drugs, including polypharmacy, and overuse of antibiotics and injections. It was observed that over 70% of patients studied received at least one injection when they visited a health facility/hospital [1]. It was obvious from this study that irrational use and overuse of injections is problematic at these facilities; this may increase the spread of HIV, hepatitis B and C, and precipitate paralysis in those suffering from acute polio infection [2–6,101]. It has also been reported that use of unsafe injections contributes to 30% of hepatitis B virus infections worldwide [101].

The WHO defines rational or appropriate prescribing as prescription of injections in less than 15% of cases, and anything above 15% is considered inappropriate injection [4]. Therefore, based on this definition, appropriate prescription of injections means prescribing injections that have a clear indication related to a particular or a specific disease. According to the Essential Drug List, any injections given where oral medications or topical drugs could be used, and where there are no clear contraindications for use of oral medications or incidence of adverse effects, such as vomiting or extensive burns, is also considered inappropriate. Overuse of injections is commonly seen in healthcare facilities in Tanzania, and is considered to be serious owing to the likelihood of adverse effects, such as pain at the site of injection, risks of abscesses, and risks of transmission of hepatitis B and C and

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HIV, as well as the economic impact [3,7,102]. Overuse of injections has also been reported in several other developing countries [8,9], and has been implicated in the spread of hepatitis B and C, and HIV [3–6,10,11,101,102]. Therefore, it is highly probable that unsafe injection practices are also prevalent in many other developing countries; however, so far no effective interventions have been conducted in Tanzania or other developing countries to prevent overuse of injections [3,4,7–10,101]. Most of the interventions, which have been carried out by the Ministry of Health in Tanzania, are confined to formal educational approaches in the form of seminars or workshops. Experiences have demonstrated that such approaches have had little impact on the consumers, and may not have had any effect on the prescribing habits of clinicians. Many prescribers express that their motives for prescribing injection are mostly caused by the customers' demands, but little or no evidence from formal studies supports this. By contrast, our experience based on focus group discussions (FGDs) with consumers demonstrated that the majority did not demand an injection, but clinicians in privately owned PHC facilities preferred to prescribe injections because they are more lucrative compared with oral medications. Therefore, it seems that the motives for an injection come from the prescribers' intention rather than from consumers' demand.

The overuse of injections is predominantly caused by prescribers, according to studies from Tanzania [7,12] and India [13], and, to some extent, caused by the consumers. From the interviews, it was found that most prescribers have sufficient knowledge regarding the proper use of injections and the risks of their misuse. However, in reality, injections are still commonly overused. It appears that, a change in prescribing behavior would require behavioral intervention strategies [8,9].

Interactional group discussion (IGD) is a form of behavioral intervention whereby participants with different motives, led by an expert administrator, interact to come to a desired behavior. This IGD approach has been used in Indonesia [14]. However, such a method is not yet commonly used to alter prescribing behavior. Considering the different motives of injection use between various prescribers as well as consumers, it might be possible to apply IGDs to reduce the misuse of injections. The IGDs focused on the discrepancy between prescribers' and consumers' perspectives regarding injections. If such an intervention method works, it may become an alternative strategy for educational intervention to improve prescribing behaviors in public healthcare facilities in Tanzania.

The objectives of this study were to assess the impact of IGDs on the prescribing behavior for injections in public and private facilities in Tanzania.

## Healthcare services infrastructure

The health delivery system in Tanzania is made up of five levels: referral, regional and district hospitals, health centers, and dispensaries. Health centers and dispensaries are referred to as PHC facilities. Hospitals are staffed with medical officers, specialists, nurses and other staff with advanced training, while health centers and dispensaries (PHC facilities) are staffed mainly by clinical officers and assistant clinical officers and, to some extent, assistant medical officers with secondary and primary education, respectively. Some PHC facilities are manned by maternal and child health aids. Some hospitals and PHC facilities in both urban and rural areas are owned by nongovernmental organizations, such as religious or faith-based organizations, and privately owned facilities [15].

## Methods

A randomized controlled trial was implemented in which ten public and ten private dispensaries in peri-urban areas of Dar es Salaam were randomly selected from a list of all dispensaries obtained from the Dar es Salaam City Medical Officer. In this study, randomization may be explained as the process in which treatments are randomly assigned to experimental units in a research design. Our experimental units were: first stage: dispensaries/facilities (public and private); and second stage: going through patient records. The research team then visited a total of 60 healthcare facilities (30 public and 30 private) for the baseline survey. A retrospective baseline survey was carried out using patient records obtained from case registers (known as MTUHA) kept in each dispensary. Prescribing data were obtained as described in the WHO manual [16]. Using WHO drug use indicator data collection forms, 30 patient records (prescriptions) from each facility were randomly selected, covering the baseline period between May and July 2005. The analysis of the baseline survey from the public and private dispensaries revealed that the prescription of injection made up over 15% of all prescriptions. The facilities with prescribing injections in over 15% of patients from ten public and ten private

dispensaries were then arranged into ascending order and paired. From each pair, a coin was tossed and re-randomized either into two groups of ten (five public and five private) control facilities (heads) and ten (five public and five private) intervention facilities (tails).

An intervention using IGDs with both prescribers and consumers was instituted in the ten intervention facilities between August and September 2005, and followed up by a 3- and 9-month postintervention survey, and evaluation in January and July 2006, respectively. No IGDs were carried out in the ten control facilities, but the survey was performed at the same time points in these facilities. Only five IGDs were conducted for all the intervention facilities and the rest were left out as this was the maximum number that was required. We also combined participants from all facilities when carrying out the IGDs in order to get a good mix of their views. This was achieved by collecting them in their respective facilities and transporting them to the venue where IGDs were undertaken. Thus, the whole study was divided into baseline, intervention and evaluation periods.

### Description of the IGDs

In the intervention arm, IGDs were used as an approach that could be effectively used to solve the problem of overuse of injections. The IGDs were conducted once for each group and lasted between 90 and 120 min. Each group consisted of six or seven prescribers and six to eight consumers. The IGDs were conducted in an informal setting (at a restaurant) by the social scientist. The moderators for each IGD consisted of a social scientist and two clinical pharmacologists who facilitated the interactions among participants in the IGDs. The discussions focused on the mismatch of views between consumers and providers that were identified from formative informal FGDs. The social scientist focussed more on the subtle confrontation regarding the discrepancies between prescribers' and consumers' beliefs and perceptions, while the clinical pharmacologists presented scientific information regarding proper use of injections. The IGD process included exploration of the feelings of participants about being included in such a group, presentation and discussion of the discrepancies between prescribers' and consumers' beliefs and motivations regarding the use of injections. The IGDs also explored motives among participants for the use of injections. Furthermore, in IGDs, the mismatch between the motives and expectations of the prescribers and consumers, with regard to injections (as found in the formative FGDs), was explored and discussed. However, immunizations were not explored as they were not considered as injections in this study. Data collection was performed manually, by note taking and using a tape recorder during the IGDs. The FGDs and IGDs were both transcribed and translated by a qualified and experienced social scientist.

### Ethical clearance

Ethical clearance for this study was granted by the National Institute for Medical Research (NIMR) Dar es Salaam, Tanzania. All participants in the FGDs and IGDs were allowed to withdraw from the study if they so wished without prior notice. Both oral and written consent was sought from the consumers (parents of the sick children under 5 years of age) and health workers before the IGDs. Thus, all participants granted consent for researchers to proceed with the study after they had explained the aims of the study clearly. Furthermore, consumers and prescribers were told that they were free to withdraw from the study and that withdrawing would not affect their future care at these dispensaries/facilities or the employment status of the prescribers (health workers).

### Postintervention survey

The same outcome variables (prescribing indicators) were measured 3 and 6 months after intervention in both intervention and control facilities, using the same procedure as in the baseline survey. Comparison of outcomes (prescribing indicators) was made previously, and compared with the 3- and 9-month follow-ups within the control and intervention facilities (both public and private). It is worth noting that during the two follow-up surveys, the consumers were not the same individuals as in the study period, nor were the prescribers in the private facilities. On the other hand, the majority of prescribers in public facilities remained the same.

### Monitoring

Monitoring was carried out from the start to the end of the project by the researchers in order to identify problems during the execution of the research and appropriate measures were taken in a timely manner while the study was being carried out.

### Data analysis

The outcome measures (proportions of injections, appropriate injections, generics and antibiotics, and the average number of drugs

dispensed) were assessed in relation to pre- and post-change using STATISTICA (statistical software) to analyze quantitative data. Significant differences between levels of indicators before and after the intervention, and between intervention and control groups, were assessed by Student's t-tests, which were based on the sample sizes selected, and differences were considered significant if $p < 0.05$. Qualitative data analyses of IGDs and FGDs were conducted using qualitative methods by a qualified and experienced social scientist.

## Results

We present the results of drug use between three time periods for the public and private dispensaries, and among control and intervention groups (Tables 1 & 2 & Figures 1–4). Of the 30 participating prescribers (from both private and public health facilities), 11 were women and the rest were men. There were 300 participants in the consumer (parents of sick children under 5 years of age) group and, of these, 200 were women and the remaining 100 were men. The age of all respondents ranged between 30 and 50 years.

### Injection use in public dispensaries

In the public dispensaries, the control and intervention groups were similar during the baseline period with regard to rate of injection use (32% in the control group versus 31% in the intervention group) (Table 1).

However, time series analysis of injection use demonstrated a sudden drop in injection from 32% at baseline to 22% during the 3 months post-IGD ($p < 0.05$). However, injection use rose again to 25% at 9 months post-IGD, although the increase was not significant when compared to baseline injection use. The overall trend of injection use was not statistically significant (Table 1).

On the other hand, the percentage of appropriately prescribed injections in the control public facilities did not differ between baseline and 3 months post-IGD (29 and 28%, respectively). However, the percentage of appropriately prescribed injections rose to 38% 9 months post-IGD (Table 1).

The rate of injection use in the intervention group fell significantly from 31% at baseline to 22% 3 months post-IGD ($p < 0.05$). However, this proportion rose again to 26% 9 months post-IGD, although the difference was not statistically significant when compared to baseline.

The percentage of appropriately prescribed injections rose from 18% at baseline to 44% 3 months post-IGD. The percentage of appropriately prescribed injections then dropped to 26% 9 months post-IGD (Table 1). The frequent use of injections was also reported by both prescribers and consumers in FGDs and IGDs. Prescribers reported that they had been treating patients who were locally circumcised and were directed by the traditional circumcisers to come for procaine penicillin fortified injection, which is an antibiotic. However, injections were still frequently prescribed for malaria, as stressed by one of the prescribers, "We will continue prescribing injections for the management of malaria until a vaccine is found."

The other prescribers argued that "it is very disheartening if one prescriber refuses to prescribe an injection or injections and the other prescriber in the same health facility accepts

**Table 1. Trend of drug prescriptions in public dispensaries among control and intervention groups.**

| Randomized group and indicator outcome | Baseline | At 3 months | At 9 months | p-value[†] |
|---|---|---|---|---|
| ***Control*** | | | | |
| Injections | 47 (32%) | 33 (22%) | 37 (25%) | 0.12 |
| Appropriate injections | 29% | 28% | 38% | – |
| Average number of drugs[‡] | 2.3 | 2.0 | 2.0 | – |
| Generics | 291 (87%) | 267 (91%) | 272 (90%) | 0.21 |
| Antibiotics prescribed | 83 (57%) | 64 (61%) | 83 (52%) | 0.03 |
| ***Intervention*** | | | | |
| Injections | 45 (31%) | 34 (23%) | 39 (26%) | 0.28 |
| Appropriate injections | 18% | 44% | 26% | – |
| Average number of drugs[‡] | 2.3 | 2.1 | 2.3 | – |
| Generics | 291 (88%) | 303 (95%) | 304 (90%) | 0.006 |
| Antibiotics prescribed | 77 (53%) | 68 (45%) | 89 (59%) | 0.05 |

[†]*p-values based on Student's t-test for trend.*
[‡]*Average number (the mean) of drugs prescribed per patient per visit.*

**Table 2. Trend of drug prescriptions in private dispensaries among control and intervention groups.**

| Randomized group and indicator outcome | Baseline | At 3 months | At 9 months | p-value† |
|---|---|---|---|---|
| ***Control*** | | | | |
| Injections | 50 (43%) | 46 (38%) | 59 (49%) | 0.23 |
| Appropriate injections | 15% | 11% | 16% | – |
| Average number of drugs‡ | 2.5 | 2.5 | 2.4 | – |
| Generics | 217 (73%) | 229 (78%) | 210 (72%) | 0.27 |
| Antibiotics prescribed | 59 (50%) | 73 (61%) | 62 (52%) | 0.21 |
| ***Intervention*** | | | | |
| Injections | 69 (47%) | 52 (35%) | 56 (37%) | 0.07 |
| Appropriate injections | 15% | 24% | 14% | – |
| Average number of drugs‡ | 2.7 | 2.2 | 2.4 | – |
| Generics | 300 (76%) | 257 (77%) | 305 (85%) | 0.006 |
| Antibiotics prescribed | 63 (43%) | 59 (39%) | 69 (46%) | 0.5 |

*†p-values based on Student's t-test for trend.*
*‡Average number (the mean) of drugs prescribed per patient per visit.*

the request. The first prescriber will look small to the consumer(s). Sometimes the consumers may even go beyond by abusing him/her".

On the other hand, owing to the frequency of malarial infections, consumers believed that injections were the best or only option. Consumers believed that tablets or syrup did not work fast enough in the management of malaria. They argued that if they did not get the injection from public facilities, they would move to the private sector. The prescribers from public health facilities were forced to prescribe injections for fear that the consumers would go to private health facilities where they would be poorly injected, leading to abscesses and boils, for which consumers would return to the public health facilities for treatment. The public health practitioners reported that they had received several cases resulting from poor administration of injections. Most of the private health facilities do not have well-trained health personnel, who know the correct methods of administering an injection(s).

## Injection use in private dispensaries

The rate of injection use in private dispensaries between the control and intervention groups were 43 and 47%, respectively (Table 2). The rate of injection prescriptions had a significant sudden drop from 43% at baseline to 38% during the 3 months post-IGD ($p > 0.05$). However, injection use rose significantly to 49% 9 months post-IGD ($p > 0.05$). Nevertheless, the overall trend between the three time periods was not statistically significant (Table 2).

The percentage of appropriately prescribed injections did not differ significantly in the control and intervention facilities (15% in both facilities). However, in the control facilities, the percentage of appropriately prescribed injections fell from 15% at baseline to 11% after 3 months, and rose to 16% 9 months post-IGD (Table 2).

Furthermore, the rate of injection in the intervention group demonstrated a significant fall, from 47% at baseline to 35% 3 months post-IGD. However, the rate rose slightly to 37% 9 months post-IGD (Table 2).

## Other drug use indicators in public dispensaries

### Average number of drugs prescribed per consumer per visit

There was no statistically significant difference in the average number of drugs per consumer between control and intervention facilities among public dispensaries at baseline (Table 1). Similarly, there were no differences in the

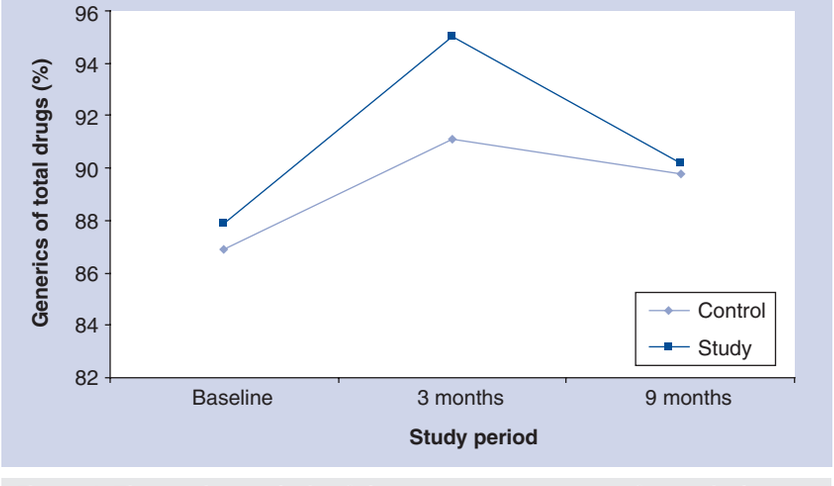


**Figure 1. Time-point analysis of the average percentage of generic drugs prescribed in public facilities.**

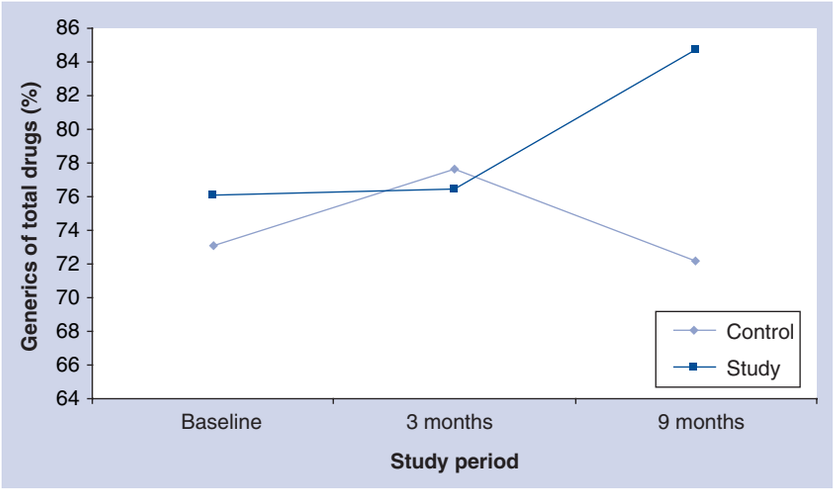


**Figure 2. Time-point analysis of the percentage of generic drugs prescribed in private facilities.**

number of drugs prescribed per consumer in both the control and intervention dispensaries in public and private facilities at baseline compared with 3 and 9 months post-IGD (Tables 1 & 2). This demonstrates that any change in the rate of injection use was not substituted with other drugs. However, the average number of drugs prescribed per patient was generally higher in the private facilities and ranged from 2.2 to 2.7 compared to the public facilities, which ranged from 2.0 to 2.3.

### Percentage of generic drugs prescribed

The proportions of generic drugs prescribed were similar at baseline in public dispensaries between the control and intervention groups (Table 1). In addition, there was no difference in the average number of generic drugs prescribed compared with baseline in the public control facilities at 3 and 9 months post-IGD (87 vs 91 and 90%, respectively) (Table 1 & Figure 4).

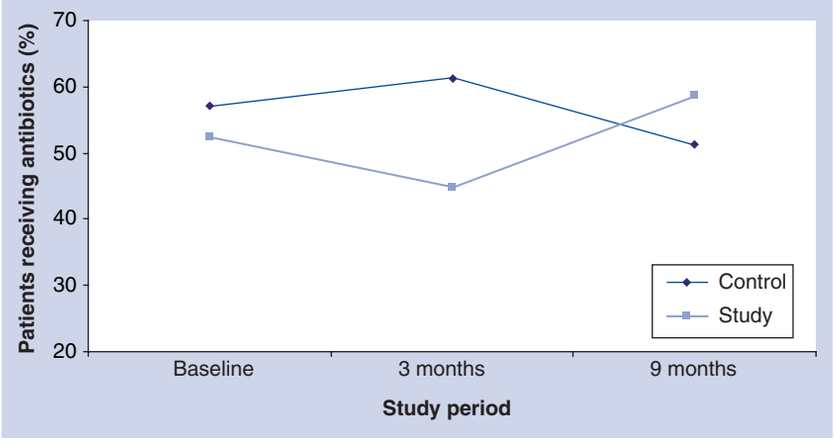


**Figure 3. Time-point analysis of the percentage of generic antibiotics prescribed in public facilities.**

However, the use of generic drugs in the intervention group rose significantly at baseline from 87.9 to 90.2% at 9 months (p = 0.006) (Table 1 & Figure 1).

Similarly, in the control private facilities, there was no statistically significant difference between the average percentage of generic drugs prescribed at baseline versus 3 and 9 months post-IGD (73, 77 and 72%, respectively) (Table 2 & Figure 2). The prescription of generic drugs among the intervention group increased significantly from 76 to 85% between baseline and after 9 months (p = 0.006) (Table 2 & Figure 2).

### Percentage of drugs prescribed as antibiotics

The percentage of drugs prescribed as antibiotics in public dispensaries did not differ significantly between the control and intervention facilities at baseline (57 vs 53%). In the public control facilities, the percentage of drugs prescribed as antibiotics rose from 56% at baseline to 61% at 3 months post-IGD ($p < 0.05$) (Table 1 & Figure 3). This fell to 52% 9 months post-IGDs and the difference was not statistically different from baseline ($p < 0.05$) (Table 1 & Figure 3). There was a significant decline in use of antibiotics between the three periods (p = 0.028) (Table 1). However, in the public intervention facilities, the percentage of drugs prescribed as antibiotics fell significantly ($p < 0.05$), from 53% at baseline to 45% at 3 months post-IGD (Table 1 & Figure 3). This rose to 59% at 9 months post-IGD and, although this difference was not statistically significant from baseline, the overall trend was very close to being significant.

In the private control facilities, the percentage of drugs prescribed as antibiotics rose from 50% baseline to 61% at 3 months post-IGD ($p < 0.05$) (Table 1 & Figure 3). This fell to 52% at 9 months post-IGD ($p < 0.05$) (Table 1 & Figure 3).

In the private intervention facilities, the percentage of drugs prescribed as antibiotics fell from 43% at baseline to 39% at 3 months post-IGD, but the difference was not statistically significant ($p > 0.05$) (Table 2 & Figure 4). This rose to 46% 9 months post-IGD (Table 2 & Figure 4).

## Discussion

Our study demonstrates that IGDs have a positive behavioral impact on injection use when carried out with both health workers and consumers (parents of sick children under 5 years of age) visiting primary healthcare facilities. There was an overall reduction in prescription of injections 3 months after intervention; however, injection

use did not improve 9 months post-IGD, indicating that, in the long term, the prescribers did not practice what they had learnt.

This finding is supported by several studies which indicate that for an intervention to be sustained it must be carried out regularly [17,18]. Furthermore, it has been reported that changing the behavior of individuals may be a difficult task and requires constant sensitization/training, monitoring and supervision for an appropriate length of time [19,20], otherwise, people tend to forget and return to their original (baseline) practices [21,22]. In Pakistan, it has been reported that people's beliefs that injections work more rapidly than other interventions drives clinicians to prescribe or give injections to consumers [6]. Furthermore, there could be financial gains that encourage health providers to prescribe injections in place of oral medications, as an additional fee is charged for administration of injections [23,24,101]. Other reasons behind consumers' preference for injections include the rituals surrounding preparation and administration of injections, experience of pain and an enhanced belief in their power to heal [25].

Close monitoring and supervision is reported to influence good performance practice for both private and public facilities [4], and injection safety promotion in order to prevent the spread of blood-borne viruses is beneficial [8,24,26,101,102]. Although this approach of monitoring and supervision improves performance, it may be seen as a Hawthorne effect, since individuals or prescribers know that they are being observed and thus change their behavior or practices. It has been previously reported that it may be difficult to achieve rational prescribing/dispensing in private facilities owing to demands imposed by consumers, advertisements from drug companies and motives for achieving profit margins [4,23,24,101].

The results also demonstrated that there were changes in the prescription of generic drugs in most facilities but no changes in injection use. The possible reasons for these differences are caused by the training that employees receive in pharmacology as emphasis is put on generic prescribing drugs, and also all essential drug program kits supplied in public PHC facilities are generic. However, there is no policy in Tanzania or in the Ministry of Health that emphasizes reduction of injection use in PHC facilities, regardless of whether they are publicly or privately owned.

To date, few interventions of this kind have been applied and evaluated with regard to changing behavioral practices [18]. In southeast Asia, it has been reported that a 'face-to-face educational' intervention, carried out for counter attendants, resulted in significant short-term improvements in the prescription of anti-diarrheal drugs and the instructions given to customers on diarrhea treatment [17].

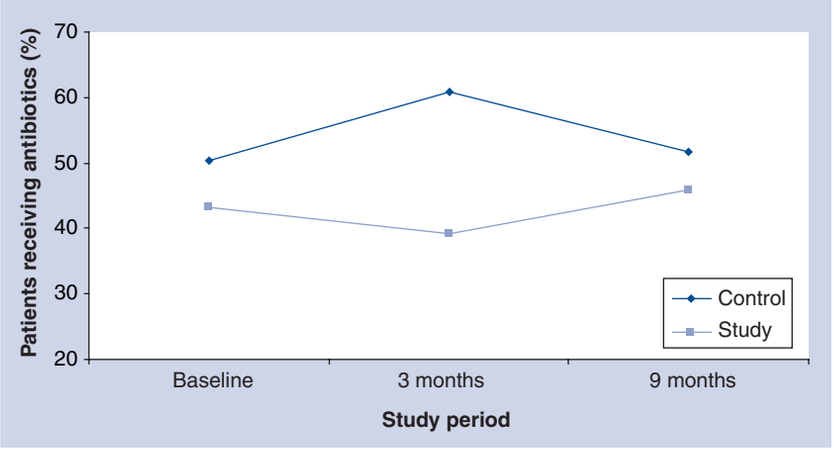


**Figure 4. Time-point analysis of the percentage of generic antibiotics prescribed in private facilities.**

The analysis appears to suggest that strategies for reducing the increasing overuse of injections have to take both the prescribers and consumers (parents of sick children under 5 years of age) into account. This is the key to improving the health of children under 5 years of age. Consumers sometimes use all their efforts to save the lives of their children when they are sick, even if this means forcing/persuading the clinician to prescribe injections to their children. However, a reduction in the misuse of injections will help to save the money spent by poor consumers for the purchase of injectables (drugs and syringes). Similarly, prescribing generic drugs helps to save money, as these drugs cost less than their branded equivalents.

On the other hand, the prescribers have to balance good clinical practice in the provision of healthcare, which they learnt at the medical colleges/institutions, and pressure from the consumers who demand injections, even for conditions that do not warrant them. However, owing to the pressure from consumers, and the fear of losing face or being labeled as an unskilled prescriber, clinicians will accept the pressure from the consumers of the sick child. Otherwise, these consumers may visit another clinician who is willing to prescribe an injection; a concern expressed by one prescriber during the FGDs.

Based on the analysis presented, there is a strong need to educate both the prescribers and nurses on good clinical practices. It has been reported that injection risk far outweighs the

risks from transfusions owing to the vast overuse of injections in developing countries [102]. Use of unclean injections and unscreened blood transfusions are the two main reasons for the spread of HIV infection in medical systems. Therefore, ensuring that medical injections are safe for patients, health workers and communities is a critical intervention [102]. Consumers should be educated and counseled that oral drugs, if used properly, do the same job as injections. Further education should be provided on prevention, especially of cholera and malaria, in particular. These are among the most common diseases that result in the prescription of injections. In addition, the public and other key stakeholders should be educated on the side effects that may be caused by injection(s), especially when administered by unskilled personnel. On rare occasions, side effects related to the injection can occur, even when it is performed by skilled and experienced personnel [4,7,10,101].

During the FGDs and IGDs with prescribers, nothing was mentioned regarding standard treatment guidelines, with the exception of the malaria treatment guidelines, and this was only mentioned in one of the FGDs with the prescribers. Such guidelines need to be provided to prescribers and their adherence should be monitored. The standard treatment guidelines might stop the clinicians from prescribing inappropriate injections.

## Limitations of the study

In this study, even control facilities (both private and public) had some reductions in the prescription of injections, which may be surprising as they never received any training/intervention. There are three explanations for the improvement seen in these facilities. Some control facilities were close to intervention facilities or some health workers from intervention facilities were living in close proximity and, thus, were likely to interact and exchange some ideas of what was happening in their facilities. This might have influenced the prescribing outcomes positively for a short time period.

The Hawthorne effect is another problem that we could not control, and might have influenced some of our results. In an experimental research design, when the subjects (e.g., clinicians and consumers) know that they are being studied for an unknown purpose or are participating in an experimental study, they change their behavior in ways that affect the results of the research study. This gives rise to the Hawthorne effect.

In addition, in the case of both public and private facilities, there were some problems related to staff retention, as some trained staff moved, were transferred or shifted from intervention facilities where they received training to control facilities and *vice versa*. Therefore, staff migration was a problem and this may have altered the prescribing performance of all facilities. As some new staff came in and were not trained at the time the study was being carried out, this could explain why some facilities performed better and others worse in terms of prescribing injections.

We did not carry out any validations to see which prescriptions of injections were appropriate and related to the diagnosis of a particular condition. Furthermore, immunizations were not explored and were not considered to be injections for the purpose of this study, although some people may consider them in this manner.

During the two follow-up surveys, it was difficult to speak to the same consumers (parents of sick children under 5 years of age) who had come back for drugs in these facilities during each study period.

### Acknowledgements

*The authors appreciate the great contribution and support from Kathy Holloway, WHO, Geneva, Switzerland, for her input during the preparation of this manuscript. The authors wish to thank the study participants (health workers in the study facilities and parents of the children). The authors are thankful to J Fulgence and W Msangi for assisting with data collection and other logistics. The authors also wish to thank the then City Medical Officer, D Mtasiwa, who is currently the Chief Medical Officer, Ministry of Health, Dar es Salaam, Tanzania, and the three District Medical Officers for Temeke, Kinondoni and Ilala, Tanzania, for allowing us to conduct the study in their respective facilities.*

### Financial & competing interests disclosure

*This study was made possible by research funds from WHO, Safe Injection Global Network (SIGN). The authors have no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.*

*No writing assistance was utilized in the production of this manuscript.*

### Ethical conduct of research

*The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.*

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