SPECIAL ARTICLE

Event-times in Intradermal Anti-Rabies Vaccination among Patients with Category II Exposure in Kolkata: Evidence for Enforcing Skill-Based Practices

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Abstract

Background: Times associated with the events in the process of Anti-Rabies Vaccination (ARV) need to be studied as these may be related not only with queuing but also with successful vaccination. To estimate different event-times within the process of ARV administration among patients with category II exposure in Kolkata. **Methodology**: An observational time-study was conducted in an ARV clinic in Kolkata among 129 patients attending with category II exposure over two-weeks. Observations were made regarding success of the vaccination process. The variability of different event-times were analysed with respect to successful or partially successful vaccination among both male and female patients. **Results:** The mean age of the participants was 26.26 (± 17.18) years with 54.26% being male. The mean time required for preparation of vaccine, drawing into syringe, having a skin-pinch & injecting the vaccine intra-dermally were 11.54, 18.44, 4.95, 9.32 seconds respectively for female patients. While for male patients these event-times were 11.27, 23.44, 5.36 & 9.66 seconds respectively. In 20.16% patients, vaccination process was partially successful. For successful vaccination, the durations for pulling skin-stretch and then injecting the vaccine were higher compared to the partially successful administering of vaccine in both the sexes. The difference of durations in injecting the vaccine was found statistically significant in both males & females. **Conclusion:** Since shorter time given in pulling skin-pinch and injecting was related to partially successful vaccination, the process should therefore be completed without any hurry to ensure proper dosing. Skill-training regarding pulling skin-pinch for ID injections & then injecting carefully may improve the service delivery.

Keywords: Anti-Rabies Vaccine, Event-times, Intra-dermal, Post-exposure Prophylaxis, Time study.

BACKGROUND:

Rabies, a fatal disease occurring in human beings after bite or exposure to animals infected with rabies virus is prevalent in over 150 countries in the world.1 Though transmission of rabies via animal bite is a global phenomenon, still Asian and African regions remain in the focus.2 In India it is estimated that around 18,000 to 20,000 people die from rabies each year, yet the true burden remain unknown.2,3 Around 40% of those bitten by a suspected rabid animal are children as reported by the World Health Organization.[1]

The Global Alliance for Rabies Control (GARC) in collaboration with World Organization for Animal Health, Food and Agriculture Organization and World Health Organization have put forward the global strategic plan “Zero by 2030” to reduce the human deaths from rabies to zero by the year

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2030.4,5 The call to unite for a zero-rabies mission has been set forth in India as well.6 It is well-understood that rabies is extremely fatal supported by the meagre number of only 15 survivors globally till date7, nevertheless completely preventable by effective and efficient public health intervention – vaccination. Post-exposure prophylaxis (PEP) is considered of monumental importance, especially in the Indian context where dog population itself is nothing but huge.

In India, the updated Thai Red Cross regimen (intra-dermal - ID) is followed for prophylaxis.8 The steps / events in giving an injection has technical considerations regarding effect of the administered drug(s).9 ARV given correctly through intra-dermal route induces the required immunity, however, the correctness is dependent upon following the standard procedure.10

There are many studies reporting adherence and the practices of the patients after animal bite.11–15 But the process related has not been studied much. However, technically event-times in the process of Anti-Rabies Vaccination (ARV) need to be studied in order to make every dose of administered vaccine count and to induce appropriate sero-response. The process as a whole is related to queuing a service delivery point and also the successful delivery of the vaccine. Among all the post-exposure categories patients with category II exposure are the most important in this regard since they are getting the vaccine only. In this backdrop the current study was conducted to estimate different event-times in the process of intra-dermal ARV administration among patients with category II exposure in Kolkata and their relationship with proper vaccination practices.

MATERIALS AND METHODS:

Study design and participants:

An observational time-study was conducted among the patients attending the animal bite vaccination clinic of ID & BG Hospital, Kolkata over one month (November – December, 2017). The study-unit in this study was the complete process of vaccination conducted on the beneficiaries. Processes where any event was not monitored for time, were excluded from the analyses. In order to calculate optimal sample size at 5% precision level 80% power the minimum required ample size was 98. To account for incomplete process observation herewith 30% inflation of sample size was done. Systematic random sampling (taking into account the average daily attendance in the clinic with category II exposure) was used to select the processes to be observed. At the end of data collection period total 129 complete processes of intra-dermal ARV injection were observed and the time events were noted. The scheme of the current study is summarized in **Figure 1**.

Definition of the events:

Apart from topical sterilization of the skin for vaccination, the process of ARV administration via intra-dermal route consists of four key events. Beginning with reconstituting the vaccine in multi- dose vial with diluent till completion of reconstitution, marked the event of preparation of vaccine. From inserting the needle of the syringe to drawing the required dose of vaccine into the needle is the second event of drawing vaccine into the syringe. Before injecting the drawn vaccine a skin-stretch is required in the target area. Starting with touching the area of vaccination by the vaccinator, stretching the skin and finally fixing the stretch with one hand, marks the event of grabbing a skin-stretch. The finally event, regarded as injecting the vaccine has been counted from putting the needle in the skin, injecting the vaccine intra-dermally till removing the needle.

Ideally, intra-dermal injection is considered successful operationally with immediate blabbing on the skin where vaccine has been injected.16 Technically success of a vaccine can only be warranted upon desired sero-conversion.16,17 However, in the current study the authors examined operational success i.e. proper method of vaccination only.

Study tools and data collection:

Time related to events in the process of vaccination was measured by stopwatch (Texla Scientific Instruments®) following standard procedures of time measurements, measuring up to hundredth of a second. The stopwatches used were pre-tested beforehand and the level of precision of the instruments were validated which is beyond the scope of this study. The event times were calculated as the time duration (in seconds) for each of the mentioned events to complete. The basic socio-demographic details like age, religion, residence pertaining to the participants were noted from the record-register after observation of the process completely.

Study variables and statistical analysis:

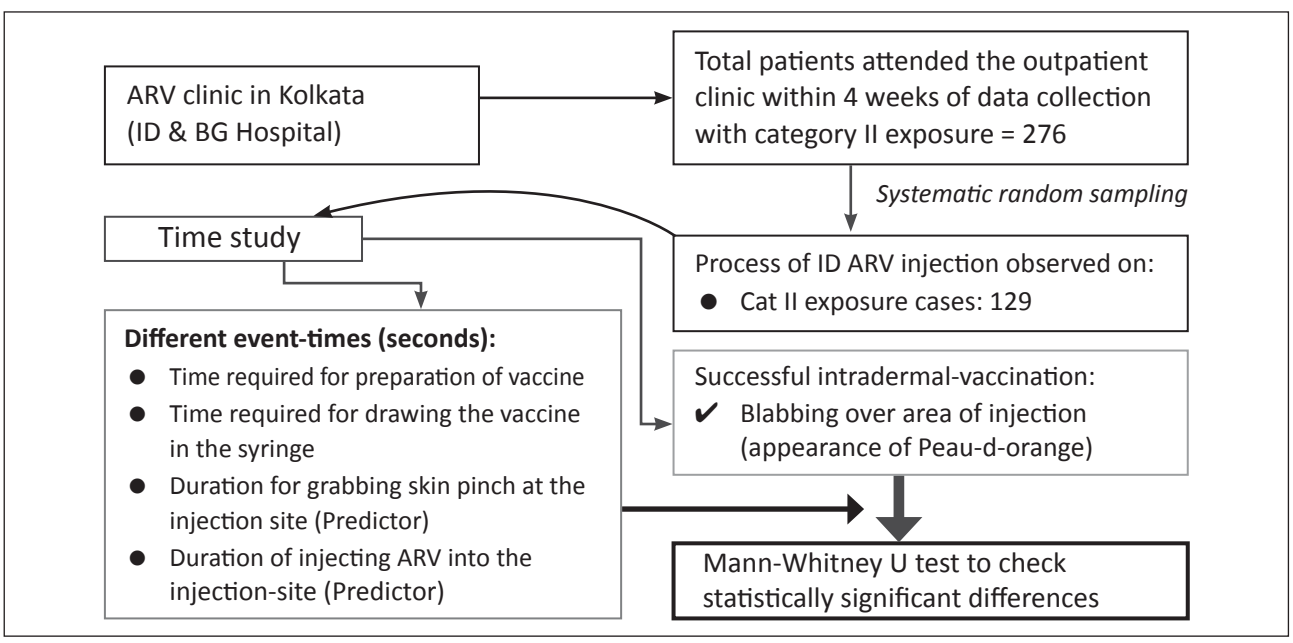
Socio-demographic variables like age, sex, religion, area of residence were considered as the background information regarding the recipients of the ARV. However, along with these, participant- independent process-related background variables were the duration of preparation of vaccine and the time for drawing it into a syringe. The primary outcome variable was operational success/ completeness of intra-dermal vaccination. The remaining two event-times i.e. duration of grabbing a skin pinch and injecting the vaccine were considered the main predictors. The event-times were represented by their mean and 95% confidence interval (95% CI). The injection of ARV is given intra-dermally in both arms at a dose of 0.1 ml each. Therefore the events of skin-stretch and injecting the vaccine had 258 observations from the 129 beneficiaries. Operational success was therefore noted separately for two arms giving 258 observations. In order to categorize outcome overall, proper blabbing in both arms consisted of successful vaccination while otherwise it was considered partial or incomplete vaccination. Because of non-normality of the two event-times the relationships with the outcome were assessed by Mann-Whitney U test. For this purpose the analysis was carried out on the

258 event-times and corresponding outcomes noted. The statistical analysis was done in STATA 14.2 (StataCorp., Texas, USA).

Ethical considerations:

Permissions were taken from the institution and the clinic. Since observing the process not only included the car-seekers but also the care-givers, both the parties were informed about the research and consent obtained. No intervention in the service-delivery was done.

Figure 1: Scheme of study



RESULTS:

Background information:

Vaccination on 129 beneficiaries attending the out-patient clinic during the data-collection period was observed. The mean age of the beneficiaries were 26.26 (± 17.18) years. The youngest beneficiary being aged 7 months and the oldest 79 years old. Among the observed beneficiaries 54.26% were male with the remaining being female. About 41.31% of were from sub-urban areas of Kolkata and 51.42% were residing within the geographical limits of Kolkata Municipal Corporation. The remaining 7.27% were rural residents. Majority were Hindu (64.43%) by religion, followed by Muslims (31.22%).

Event-times in ID vaccination ARV:

The mean duration of different events in the process of ARV administration are summarized in Table1. Preparation of vaccine vials for drawing vaccine was observed to be completed in 11.395 seconds (95% CI: 11.168 – 11.623). Forty-one such vials (as supplied vials were multi-dose) preparation was observed and the estimate was calculated. The duration was comparable among males and females. The average duration taken by the health care providers to draw the vaccine into the syringe and prepare for injection was 21.155 seconds (95% CI: 20.242 – 22.068). The mean duration for stretching of skin before the process of injection was 5.171 seconds (95% CI: 4.729 – 5.612). This duration was noted to be 4.949 seconds (95% CI: 4.502 – 5.396) and 5.357 seconds (4.628 – 6.087) respectively for female and male beneficiaries. The difference was not statistically significant. The mean duration of intra-dermal injection of vaccine was 9.504 seconds (95% CI: 9.239 – 9.769). For male recipients the mean duration was observed to be 9.657 seconds (95% CI: 9.338 – 9.976). Similarly for females it was 9.322 seconds (95% CI: 8.877 – 9.767). Again the difference of mean duration of injecting vaccine among the different genders was not different statistically.

Operational outcome of vaccination and the relationship with event-times:

Operationally complete / successful vaccination was observed in 79.84% of the beneficiaries. In the remaining 20.16% of the recipients the vaccination process was not operationally successful in case of injecting the vaccine in right or left arm. No beneficiary had unsuccessful blabbing over both the arms after ID administration of ARV. While among female recipients 22.03% had partially unsuccessful vaccination, among the males the proportion was 18.57%. The observed proportions did not statistically differ sex-wise.

Figure 2 depicts the confidence interval bars for the mean durations of grabbing the skin-stretch among the vaccine recipients. Among the female beneficiaries those who had successful vaccination (appearance of blabbing), the mean duration of skin-stretch was 5.043 seconds (95% CI: 4.498 – 5.589) compared to those with partially successful vaccination having the duration of 4.615 seconds (95% CI:3.895 – 5.336). Among the males, the mean duration for skin-stretch was observed 4.154 seconds (95% CI: 3.557 – 4.750) among those who had partially successful vaccination and 5.631 seconds (95% CI:4.755 – 6.508) among successfully vaccinated. The higher duration for grabbing the skin stretch for those having successful vaccination was statistically true for the male recipients but not in females. On overall analysis this hypothesis of difference in duration of skin-stretch in operational success was rejected.

The confidence interval bars in Figure 3 represents the mean durations in injecting the ARV and compares them gender-wise dependent on the operational outcome. While comparing the time taken for injecting ARV intra-dermally, the males who received successful vaccination documented a mean duration of 9.833 seconds (95% CI: 9.533 – 10.134) but for partially successful vaccination it was 8.885 seconds (7.746 – 10.022). Amongst the females the mean durations were respectively 9.696 seconds (95% CI: 9.208 – 10.183) and 8.000 seconds (95% CI: 7.250 – 8.750). Overall the difference in mean duration taken for vaccination was statistically significantly different

between successfully and partially successfully vaccinated beneficiaries with the duration higher for those with successful/ complete vaccination. While this observation did not hold true among the males, amongst females the duration of injection was statistically higher for those who had successful vaccination.

Table 1. Distribution of event-times among different genders.

Events in ID ARV administration	Female (n=59) Mean Duration (in seconds) (95% Confidence Interval)	Male (n=70) Mean Duration (in seconds) (95% Confidence Interval)	Overall (n=129) Mean Duration (in seconds) (95% Confidence Interval
Preparation of vaccine	11.542 (11.189 – 11.896)	11.271 (10.971 – 11.572)	11.395 (11.168 – 11.623)
Drawing the vaccine into the syringe	18.441 (17.321 – 19.560)	23.443 (22.279 – 24.606)	21.155 (20.242 – 22.068)
Stretching of skin over the area of injection	4.949 (4.502 – 5.396)	5.357 (4.628 – 6.087)	5.171 (4.729 – 5.612)
Intradermal injection	9.322 (8.877 – 9.767)	9.657 (9.338 – 9.976)	9.504 (9.239 – 9.769)

Figure 2. Outcome-wise difference in mean duration for grabbing skin stretch among different genders.

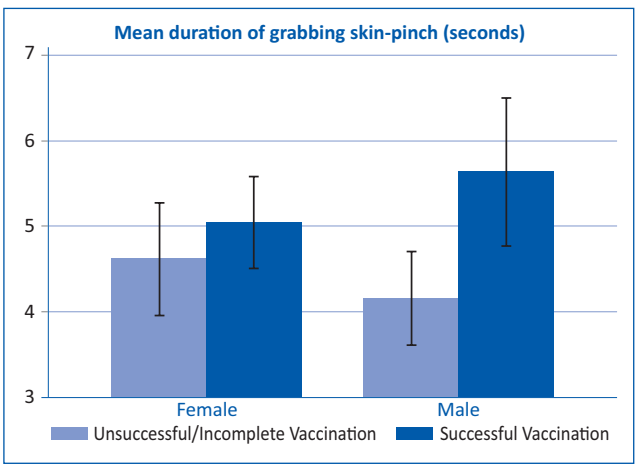
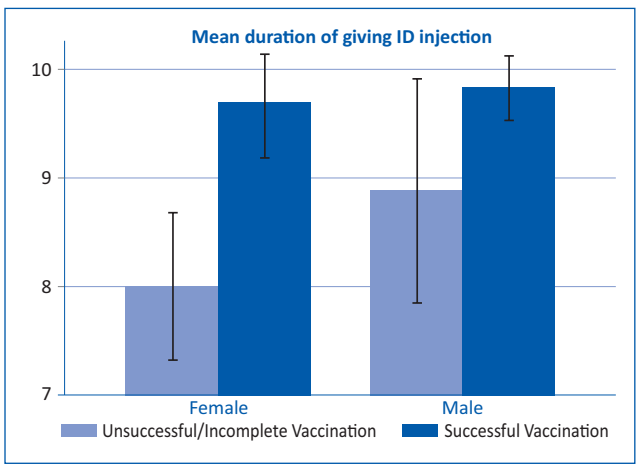


Figure 3: Outcome-wise difference in mean duration for injecting ARV among different genders



DISCUSSION:

Analysis from the current study revealed that shorter time given in skin-stretch and injecting was related to unsuccessful vaccination. However, there is need for developing an optimum time framework for vaccination events in this regard. The WHO has emphasized on training of manpower to achieve successful vaccine delivery through intra-dermal route and making every dose count.18 The question still looms large is regarding the trade-off between accuracy of vaccination and the minimum time spent for the process. It is enforced that for effective vaccination the full dose (0.1 ml) should be given intra-dermally.17 However, the dose increases if the route is not intra-dermal. Hence the issue of incomplete immune reaction if administration of vaccine is not intra-dermal properly. Laurent et al.19 in their study observed improper vaccination practice leads to poor clinical performance. This is a matter of concern since the global aim to reach “zero by 2030” depends much on the methodological accuracy. Skill-training regarding stretching of skin properly for ID injections appears to be an aspect for supportive supervision to improve the skills involved. Laurent et al.19 recommended new delivery system like microinjection system can be considered to overcome skill-gap. The current study was conducted with a lower power due to

resource constraints, but definitely paves way for future large-scale time-studies in this regard. While steps of the process are enumerated under standard operating procedure16, the technical aspects need to be standardized further to aim for even more objective skill-training. Time is one aspect of standardization. Motion studies conducted on the process will help in identified the important sub-events and thereby ensuring robustness of the guidelines. While recommendation regarding rigid time duration for the events may not be apt based solely on the study, but it can be safely said that longer duration given in the key steps ensures successful delivery of the vaccine.

The process of ID injection should be completed without any hurry to ensure proper dosing. In order to decrease the wastage of vaccine and making operationally successful vaccination training of the personnel associated should be undertaken periodically. Injecting ARV carefully and skill-fully may not only improve the service delivery, conceptually it will also result in a better patient compliance. As an alternative to the manual skill-based approach, mechanical intra-dermal vaccine delivery systems can be considered for this purpose which in fact requires further research.

KEY MESSAGE:

The process of intra-dermal injection should be completed without any hurry to ensure proper dosing. In order to decrease the wastage of vaccine and making operationally successful vaccination training of the personnel associated should be undertaken periodically. Injecting ARV carefully and skill-fully may not only improve the service delivery, conceptually it will also result in a better patient compliance.

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CONFLICT OF INTEREST: None declared.

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