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Title- TIME MOTION STUDY IN ARV OPD

Name(s) of the author(s):ASMITA PATNAIK [1], ANSHUMAN DASH [2], SATYARANJAN ACHARYA[3], SIKATA NANDA[4]

Affiliation(s) of author(s) (including current affiliation and affiliation where the work was primarily carried out):

1st Author-Senior Resident, Dept of Community Medicine, S.C.B. Medical College and Hospital, Cuttack, Odisha, India

2nd Author-3rd Year PG Student, Dept of Community Medicine, S.C.B. Medical College and Hospital, Cuttack, Odisha, India

3rd Author-Senior Resident, Dept of Paediatrics, S.C.B. Medical College and Hospital, Cuttack, Odisha, India

4rth* and Corresponding Author- AssociateProfessor, Dept. of Community Medicine, S.C.B. Medical College and Hospital, Cuttack, Odisha, India

Name and postal address of corresponding author:

Dr. Sikata Nanda, Associate Professor, Dept. of Community Medicine,1st Floor, Kalpana Residency, Emporium Lane,Rainhat, Cuttack,753001, Odisha, phone no- 9437740042

Email address(es) of all authors

Asmita Patnaik - asmita211194@gmail.com,8847856712

Anshuman Dash- ilovemyindia.anshuman@gmail.com,7377787554

Satyaranjan Acharya- satyaranjanacharya122@gmail.com ,7205789399

Sikata Nanda - drsikatanandadmet@gmail.com,9437740042

Running title:Patnaik et al

A B S T R A C T

Background & Aim:Patient treatment actually involves a series of activities prior to and at the time of anti-rabies vaccination (ARV) treatment. This study highlights thetotal estimatedtime during vaccine delivery.The entire method consists in fragmentation of the process into essential activities and involves the measurement of each specified activity by trained observers using synchronised stopwatch. The study aims at calculating the time by healthcare personnelsin vaccine administration.

Materials and Methods: A cross-sectional study was carried out in ARV (Outpatient Department) OPD in a tertiary care hospital in the eastern part of Odisha involving all patients attending ARV OPDduring 1st July 2021- 31st August 2021.

Results: The present study was conducted with 1440 participants i.e., 625 males (43.4%), 811 females (56.3%) and 4 trans-genders (0.3%).Majority of cases i.e., 419 (29.1%) were less than 15 years of age and the most common attacking animal were dogs followed by cats. The maximum time spent by the patients was following the immunoglobulin administration till the procurement of medications i.e., 38.67 ± 6.98 minutes.

Conclusion: The patients were tracked and found that time motion was dependent on number of factors like at any given point on number of patients, serious patients, the time taken by doctors required to take the detailed history was of course significantly associated with the longer overall time motion.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

Keywords: Patient care, ARV clinic, Time motion, stopwatch

INTRODUCTION:

In the early 20th century time motion studies were first described in industrial engineering, referring to a quantitative data collection method where an external observer captured data on the duration and movements required to accomplish a specific task, coupled with an analysis focused on improving efficiency. In effective hospital management different factors like waiting time in OPD and reduction of patient congestion is a difficult issue of hospital administration which should be prioritised[(1)]. Adoption of Queuing technique is an appropriate solution to this underlying problem. So there is a necessity of a good balance between the number of health care providers,availability of vaccines, costs information on animal bite cases and optimal performance[(2)]. Most important is to understand how patients spend their time before returning back after consultation. Time-motion methodology provides information on how much time it takes to listen carefully to history, categorisation of animal bite vaccine prescription, preparation, where required skin testing, waiting area and finally vaccination and disposal of drugs. The aim is to understand how people do their work in order to determine areas of inefficiency and to improve workflow.

The quality and efficacy of treatment at the hospital can be evaluated by the patient's outcomes and their waiting time. Prolonged waiting time has a significant association with patient's dissatisfaction. Partly, waiting time is associated with the patient turn over but the hospital management must be geared to tackle any such obvious problem and try all measures to reduce the waiting times. With longer patients look for alternate health facility and, in the process, end up spending even more time in chaos and meanwhile loose the window of opportunity for their better outcome. Timely treatment at the emergency room (ER) improves patient's outcomes and may save precious lives.

OBJECTIVES:

1. To find out the operational efficiency of various activities carried out in the anti-rabies outdoor.
2. To assess the level of satisfaction of patients attending this OPD.
3. To suggest recommendations.

Material and methods:

Type of Study: Hospital based study

Study place: Anti-rabies outdoor of SCB MCH, Cuttack

Study time: 1st July 2021- 31st August 2021

Study duration: 2months

Study population: All patients attending ARV OPD

Sampling: Systematic random sampling

Sample size: Systematic random sampling was done.

Total new patients on an average per day: 45, 10% of this: approx. 4 per day (2 in the 1st half, 2 in 2nd half)

Total old patients on an average per day: 80, 10% of this: approx.: 8 per day (4 in each half)

Total 30 working days/ month, therefore 120 new plus240 old cases i.e., 360 cases.

Hence in 2 consecutive months total 360 * 2 =720 cases

Applying design effect, final sample size was calculated to be: 720*2 =1440

Since the total number of patients in 2months is approximately 1586*2 = 3172.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

Sampling interval turns out to be 3172/1440i.e., every 2nd patient was chosen for interviewing by thePost Graduate Students (PG) students.

Methodology: Every selected participant was observed without getting noticed by the staff of the outdoor and the time was recorded using the stopwatch of smartphone. Finally, after the administration of ARV vaccine,Tetanus Toxoid and Equine Rabies Immunoglobin (ERIG) the patients were kept under observation, then informed consent was obtained from them and their interview was taken. Contact number of the patient was noted down for further follow up regarding procurement of medication. In case phone number was not available, then an intern was asked to accompany the patient until he/she has procured the medicines.

Study instruments:

- A pre-designed pre-tested questionnaire was used after validation by faculty members of department of community medicine.
- Stop watch of a smart phone was used to record time in seconds.
- Socio-demographic details, case details and treatment profile were recorded using online data collection tool i.e., Google forms.

Data analysis:

All the collected data was entered in Microsoft Excel(MS) excel spread sheet and analysed using Statistical Package for Social Scientists (SPSS) version 25.0. Mean and standard deviation was calculated for continuous variables, independent sample t-test and One-way Analysis of Variance (ANOVA) was used to find out association between continuous and categorical variables. Chi-square test was employed to compare two categorical variables. Outline of the ARV OPD was prepared using MS word.

RESULTS:

TABLE 1:Comparative Analysis of Average time Duration at Different point of Contact(Length of time in Minutes) in new and old cases

Table No.	Mean Time (in minutes)	SD	Mean difference	t-value
ENTRY POINT to TABLE 1 (registration counter to doctor's table)			**3.65**	**7.829**
OLD CASES	**12.88**	**7.47**		
NEW CASES	**16.54**	**9.90**		
TABLE 1 TO TABLE -2 (doctor's table to getting vaccine and test dose)			**4.42**	**112.06**
OLD CASES	**0.35**	**0.12**		
NEW CASES	**4.78**	**1.21**		
TABLE 2 TO TABLE 3 (from				

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

getting the test dose till the end of waiting for skin test review)				
OLD CASES	**00**	**00**		
NEW CASES	**16.51**	**1.21**	**16.51**	**422.13**
TABLE 3 TO TABLE-4 (review of test till end of RIG administration)				
OLD CASES	**00**	**00**	**11.16**	**176.86**
NEW CASES	**11.16**	**1.95**		
TABLE -4 TO EXIT (end of RIG till procurement of medicines)				
OLD CASES	**00**	**00**	**38.67**	**171.70**
NEW CASES	**38.67**	**6.98**		
ENTRYPOINT to Exit POINT				
OLD CASES	**13.23**	**7.46**	**74.44**	**136.04**
NEW CASES	**87.67**	**13.27**		
All the values are significant at p<0.001				

Table 1 shows the average time taken by old and new animal bite cases at each table on the particular day of their visit. There was a difference of 3.65 minutes among the old and new cases from the central registration counter till the beginning of consultation by the physician which was attributed to the fact that after the 1st time consultation, for subsequent visits only a stamp was required instead of a new OPD ticket on each visit. The follow-up cases only visited for intradermal Anti-rabies vaccine. Therefore, they didn't have to wait for immunoglobulin skin test results and immunoglobulin administration. Therefore, on an average, while the old cases required 13.23 minutes to get their vaccine, the new cases required 87.67 minutes. The difference in the total time taken between old and new ARV patients in the OPD was statistically significant with p<0.001.

TABLE 2: DAYWISE COMPARISION OF TOTAL TIME TAKEN IN DIFFERENT TABLES IN ARV CLINIC (separate for new and old)

	Entry to table 1		**Table 1 to 2**		**Table 2 to 3**		**Table 3 to 4**		**Table 4 to exit**	
	NEW	**OLD**	**NEW**	**OLD**	**NEW**	**OLD**	**NEW**	**OLD**	**NEW**	**OLD**
Mon	**16.03 (10.2)**	**12.76 (6.8)**	**4.9 (1.23)**	**0.35 (0.1)**	**16.65 (1.1)**	**-**	**11.05 (1.9)**	**-**	**38.57 (6.9)**	**-**
Tue	**17.19 (10.5)**	**12.86 (7.5)**	**4.8 (1.2)**	**0.34 (0.1)**	**16.54 (1.1)**	**-**	**11.29 (2.0)**	**-**	**39.16 (6.8)**	**-**
Wed	**16.08 (9.0)**	**12.57 (7.0)**	**4.7 (1.2)**	**0.36 (0.1)**	**16.50 (1.2)**	**-**	**10.76 (1.2)**	**-**	**38.22 (7.0)**	**-**
Thurs	**16.80**	**13.47**	**5.1**	**0.36**	**16.19**	**-**	**10.98**	**-**	**38.03**	**-**

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

	(9.5)	(8.5)	(1.3)	(0.1)	(1.3)		(2.0)		(6.9)	
Fri	**16.75 (10.7)**	**12.46 (7.3)**	**4.7 (1.1)**	**0.32 (0.2)**	**16.70 (1.3)**	**-**	**11.22 (1.8)**	**-**	**38.11 (7.4)**	**-**
Sat	**15.22 (8.3)**	**13.75 (8.9)**	**4.4 (1.1)**	**0.33 (0.1)**	**16.36 (1.2)**	**-**	**11.25 (1.9)**	**-**	**39.48 (6.7)**	**-**
Sun	**16.86 (9.8)**	**14.15 (8.8)**	**4.5 (1.0)**	**0.36 (0.2)**	**16.41 (1.2)**	**-**	**11.48 (1.9)**	**-**	**38.74 (7.1)**	**-**

Table 2 describes the time taken by old and new cases by the patients on different days in a week using one-way ANOVA. The new cases required slightly more time from registration to the 1st consultation on Tuesdays and least time was needed on Saturdays. Not much difference was observed for the same among the old cases throughout the week. But these results were not statistically different. There was no significant difference in the time required by the new cases for consultation with the physician to get the vaccine shot. This pattern may be attributed to the constant patient load throughout the week with not much variation.

TABLE 3: TIME OF DELIVERY OF SERVICE ATDIFFERENT POINTS IN OLD AND NEW ARV CASES:

TIME OF THE DAY OF VISIT	**Mean total time (in mins) ***			**MEDIAN TIME (in mins)**		**INTER QUARTILE RANDE(Q3-Q1)**	
	Old case	**New case**	**t-value**	**Old case**	**New case**	**Old case**	**New case**
9.00 -11.00 A.M	**13.83 (8.1)**	**89.31 (14.4)**	**63.644**	**10.70**	**86.32**	**4.4**	**16.91**
11.00-1.00 P.M	**12.88 (6.9)**	**88.42 (13.8)**	**79.755**				
2.00-3.00 P.M	**12.69 (6.8)**	**86.08 (11.7)**	**71.273**				
3.00-5.00 P.M	**13.69 (8.1)**	**85.98 (12.2)**	**43.044**				
***:Values are significant at p<0.001**							

Table 3 depicts the variation in time required for delivering various services in the ARV OPD at different times during the day. Maximum time was required by the patients during 9am to 11 am as compared to rest of the day. For the new cases, the mean total time required was maximum at 9am to 11am i.e., 89.31 ± 8.1 minutes and minimum was between 3pm to 5pm i.e. 85.98 ± 12.2minutes. These results were statistically significant at $p<0.001$. While no such pattern was observed for old or follow-up cases which might be attributed to the lack of waiting post-immunoglobulin administration as well as non-requirement of further medications after vaccination. The median time required by new cases was 86.32 minutes while for old cases was 10.70 minutes. The inter-quartile range varied from 16.91 minutes to 4.4 minutes between new and old cases respectively.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

TABLE 4: ASSOCIATION BETWEEN CATEGORY OF EXPOSURE AND AGE AND AVERAGE TIME DURATION

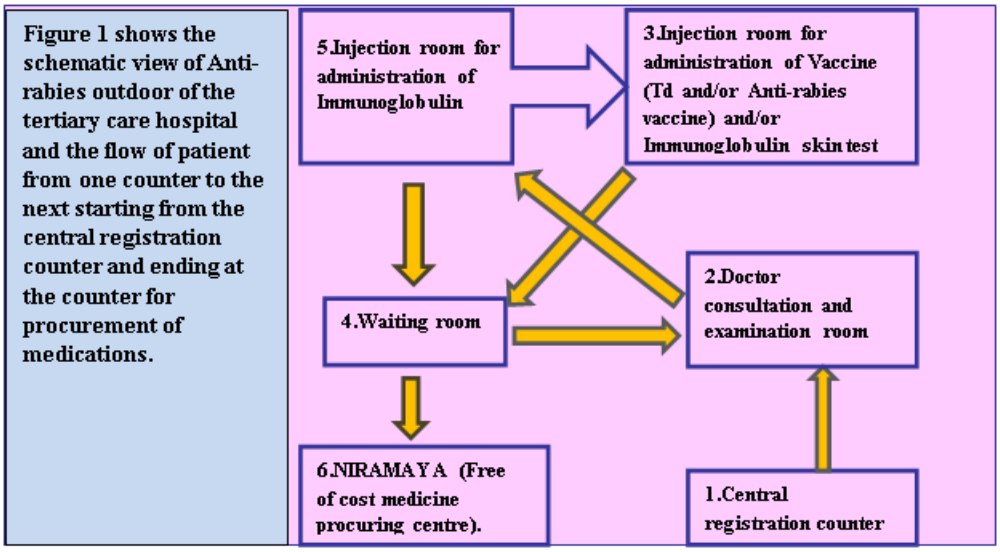
TYPE OF EXPOSURE	AGE GROUP IN YEARS				*p*-value	X^2
	0-15	16-30	31-45	>46		
CATEGORYII	30 (14.9)	92 (45.5)	32 (15.8)	48 (23.8)		
CATEGORYIII	389 (31.4)	219 (17.7)	315 (25.4)	315 (25.4)	<0.001	85.617
Total	419 (29.1)	311 (21.6)	347 (24.1)	363 (25.2)		

Table 4 describes the proportion of category II and Category III animal exposure cases in different age groups. Majority of Category III cases were observed among children aged less than 15 years i.e., 389 (31.4%) and the least was observed among those aged 16 to 30 years i.e., 219 (17.7%). This might be attributed to the carelessness of parents, increasing trend of keeping pets at home and lack of ability of children to defend themselves from animals. Maximum number of Category II cases were seen among young adults i.e. those between 16 to 30 years of age. Marginal difference was observed between children and older adults between 31 to 45 years of age i.e., 30 (14.9%) and 32 (15.8%) respectively. Overall, almost equal proportions of cases were found in all the age groups with not much difference. All these values were statistically significant at p<0.001.

OPD LAYOUT:

Tables: 1= registration, 2= doctor, 3= vaccination, 4= skin test waiting, 5= ERIG, 6= post ERIG waiting.

FIGURE 1: OUTLINE OF ANTI-RABIES OUTDOOR



ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

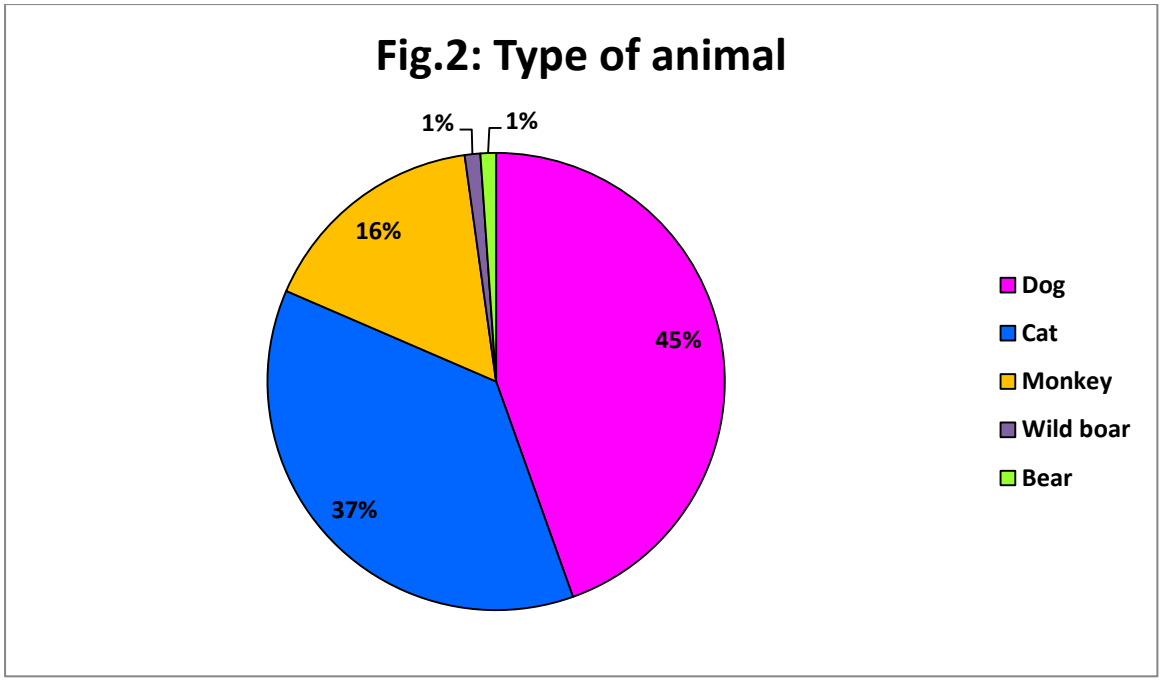


Figure 2 shows the different types of animals following whose exposure patients visited ARV OPD. Maximum cases i.e. 45% were exposed to dogs (both pets as well as street dogs) followed by cats (37%) and monkeys (16%). 1% each of wild boar (*Barha* in local dialect) and wild bear cases were also encountered in the OPD.

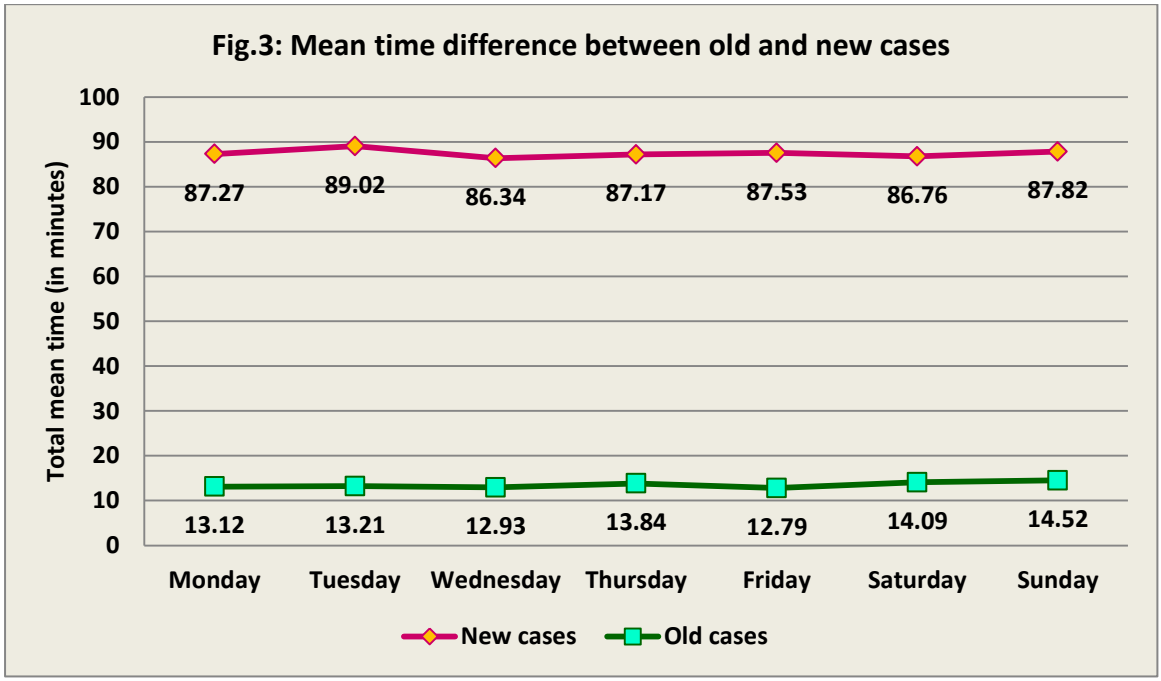


Figure 3 shows the mean total time difference starting from OPD registration till procurement of medication among old and new cases. The maximum time required by new cases was observed on Tuesdays and minimum on Wednesdays. However, not much difference was observed in the time spent by old cases which may be attributed to the fact that they only visited for intra-dermal vaccine administration which did not require any prior skin testing review and post-administration waiting.

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

TABLE 5: BODY PARTS AFFECTED and TYPES OF WOUND V/S GENDER

ANATOMICAL SITE				
	Males (%)	**Females (%)**	***p*- value**	**χ**
HEAD AND NECK	**105 (16.8)**	**190 (23.4)**	**0.005**	**10.552**
UPPER LIMBS	**199 (31.8)**	**404 (49.8)**	**<0.001**	**48.575**
LOWER LIMBS	**377 (60.3)**	**403 (49.7)**	**<0.001**	**20.801**
TRUNK	**71 (11.4)**	**67 (8.3)**	**0.114**	**4.336**
GENITALIA	**16 (2.6)**	**46 (5.7)**	**0.014**	**8.477**
TYPE OF WOUND				
ABRASION	**284 (45.4)**	**446 (55.0)**	**<0.001**	**96.835**
LACERATION	**89 (14.2)**	**216 (26.6)**		
PUNCTURE WOUNDS	**252 (40.3)**	**149 (18.4)**		

Table 5 depicts the distribution of animal exposure based on anatomical sites and based on type of wound among males and females.A significantly higher number of females suffered from injuries to head and neck i.e., 190 (23.4%), upper limbs i.e., 404 (49.8%) and genitalia i.e., 46 (5.7%) as compared to males. On the other hand, higher number of males suffered from injuries to lower limbs i.e., 377 (60.3%) and trunk i.e., 71 (11.4%) than females.

TABLE 6: LEVEL OF SATISFACTION OF ATTENDEES OF THE OPD

Responses	**Patient satisfaction levels [N (%)]**				
	Satisfied	**Average satisfied**	**Not satisfied**	**Don't know**	***p*-value**
Too long	**08 (3.1)**	**172 (66.9)**	**48 (18.7)**	**29 (11.3)**	**<0.001**
As per need	**267 (45.1)**	**202 (34.1)**	**75 (12.7)**	**48 (8.1)**	
Too short	**319 (72.3)**	**101 (22.9)**	**21 (4.8)**	**00**	
Cannot say	**09 (6.0)**	**15 (10.0)**	**10 (6.7)**	**116 (77.3)**	
Total	**603 (41.9)**	**490 (34.0)**	**154 (10.7)**	**193 (13.4)**	

Table 6 describes the levels of satisfaction based on their perception about the tentative time they spent in a single visit to the OPD. Majority of the patients i.e., 603 (41.9%) of patients were satisfied and 490 (34%) were averagely satisfied while 154 (10.7%) were not satisfied. This pattern may be attributed to higher number of follow-up cases who solely visited for intradermal vaccine which is much less time consuming. Among those who were satisfied,

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

most of them i.e., 319 (72.3%) perceived the time required to be too short and the individuals who were not satisfied, were indecisive about their time perception. All these findings were statistically significant with *p* value less than 0.001.

DISCUSSION: The present study was carried out in the anti-rabies outdoor of a tertiary care hospital in Eastern Odisha. This hospital provides service to patients residing in Odisha as well as in the neighbouring states like Bihar, West Bengal, Telangana as well as Andhra Pradesh. Daily out-patient numbers ranges from 3000 to 7000 across more than 20 outdoors including broad specialities and super specialities.

Time and motion studies have been conducted worldwide in non-health care settings like the one conducted by **Rehman AU et al**[3]in Pakistan to assess the efficiency of apparel manufacturing by proper floor management as well as in health care settings to assess administrative efficiency of the hospital as seen in the studies conducted by **Zheng K et al**[4], **Tipping MD et al**[5], **Leafloor CW et al**[6]**, Oostveen CJ et al**[7] and **Lim LM et al**[8]**.** Also, many similar studies have been carried out in different specialities and broad specialities like the ones conducted by **Palma AM et al**[9] in HIV clinics of Swaziland, **Were MC et al**[10] in HIV counselling and prevention centres in Kenya, **Singh R et al**[11] in Paediatric ER centre in Chandigarh and **Sah RI et al**[11] in a tertiary care eye hospital in India.

SOCIODEMOGRAPHIC AND CASE PROFILE: The present study was conducted with 1440 participants i.e., 625 males (43.4%), 811 females (56.3%) and 4 trans-genders (0.3%). The mean ages were 32.36 ± 21.2, 32.49 ± 21.2 and 23.75 ± 0.5 years for males, females and trans-genders respectively. Majority of cases i.e., 419 (29.1%) were less than 15 years of age which may be due to increased vulnerability of kids, lack of parental supervision as well as increasing numbers of street animals in rural as well as urban areas. But in a study conducted by **Sinha RR et al**[12] in ARV OPD in a tertiary care hospital of Bihar, 77.3% were males and rest were females which is in contrast to our study and 34.8% cases were aged less than 15 years which is much higher than that found in the present study. In another study by Behera et al, near about half of the participants were aged 15 to 45 years of age.

The most common attacking animal was dog (45%) followed by cat (37%) in our study which may be due to the increasing trend of keeping pets at home as well as caressing street animals. These findings are in corroboration with other similar studies conducted by **Sinha RR et al**[12] **, Behera et al**[13] and **Sudarshan MK et al**[14].

DISTRIBUTION OF TIME SPENT AT VARIOUS STATIONS IN OUT-PATIENT DEPARTMENTS: In our study, the maximum time spent by the patients was following the immunoglobulin administration till the procurement of medications including post-RIG observation time for Type-1 hypersensitivity reactions i.e., 38.67 ± 6.98 minutes. This time wastage may be attributed to the lower availability of (Human RabiesImmunoglobulin) HRIG which causes minimal to zero post-injection hypersensitivity reactions and sufficient availability of Equine-RIG which has higher chances of such reactions. Also, there are two *Niramaya* (free-of-cost medicine procurement centre) in the entire campus which makes it too much crowded throughout the day. The next time-consuming procedure was between OPD registrations and till the point of reaching for physician's consultation i.e.,16.54 ± 9.90 minutes and 12.88 ± 7.47 minutes for new and old cases respectively which may be due to high patient load throughout the week in the hospital and presence of a single central registration counter for all the departments. Minimal time was spent in doctor's consultation

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

and getting the intradermal vaccine shot i.e., 4.78 ± 1.21 and 0.35 ± 0.12 minutes for new and old cases respectively.

In a study conducted by **MokiouS et al**[15] in England found the mean total vaccine administration time to be 8.4 minutes which is much higher than our finding. In another study conducted by **TantraS etal**[16] in an Ayurvedic OPD in New Delhi, the mean registration times and mean waiting time at OPD was found to be 10.36 ± 6.44 minutes and 77.43 ± 13.33 minutes respectively. In a study conducted by **Chopade RR et al**[17] in the OPD of RHTC in Konkan region, the mean time to avail OPD services was 56 minutes. **Aswar et al**[18] and **Umar et al** found these services to take 75.5minutes and 85minutes on an average due to the requirement of a thorough history taking and vigilant clinical examination of the patients. All these findings are much higher than our study finding. In a study conducted by **Manna N et al**[19]in the OPD of rural hospital of west Bengal, **Anand TR et al**[20] and **Sengupta B et al**[21] in general OPD of West Bengal, it was observed that maximum mean time was taken from registration counter to the point of reaching to the doctor's table but the consultation time was less similar to our finding. In a similar study by **Naaz F et al**[22], it was found that maximum time was spent by the patient was for consultation i.e. 1 hour 10 minutes followed by at the pharmacy i.e. 16minutes which is similar to our study finding where the mean total time taken by a patient in a single visit to the Anti-rabies outdoor was 87.67 ± 13.2 minutes and 13.23 ± 7.46 minutes for new and old cases respectively.

In our study, a significant difference was observed in the mean time required for various activities among new and old cases where new cases required much higher time than older cases similar to the findings of **Chopade RR et al**[17]. However, no significant difference was observed in different days of a week because the patient load remained almost similar throughout the week including weekends. This is in contrast to the findings of **Chopade RR et al**[17] and **Manna et al**[19] where the maximum case load was found during Mondays as compared to rest of the days which may be due to the fact that those studies were conducted in genera OPDs of rural areas. For both old as well as new cases, there was a significant difference in the total mean time required for all the activities at different times throughout the day. Maximum time was consumed per patient between 9am to 11 am and minimum between 3pm to 5pm. This may be due to the fact that patient load remains maximum during the initial hours of OPD and as the day passes, it gradually reduces. These findings were statistically significant with p-value <0.001.

In studies conducted by **Kumar V et al**[23] in immunization Out Patient Department (OPDs) attached to Rural Health Training Centre (RHTC)in New Delhi and **Chattopadhyaya A et al**[24] in immunization OPD of a tertiary care hospital of West Bengal, it was observed that maximum time for registration was taken on Mondays. The time taken for registration of old cases was more than new cases which is in contrast to our finding. In both these studies, maximum time was spent on post-vaccination advice, similar to our study where maximum time taken was after the completion of immunoglobulin administration.

In a study conducted by **Chopade RR et al**[17],26.67% of study participants considered the time taken in OPD to be too long and 26% of patients were not satisfied. Only 34% of patients were satisfied. These values were much lower than our study finding. In another study conducted by **Umar et al**[25], 45% of patients were satisfied, similar to our study finding. In other similar studies conducted by **Aswar NR et al**[26] and **Chetwynd et al**[27] the

ISSN: 0975-3583,0976-2833 VOL13,ISSUE05,2022

levels of satisfaction was found to be 65.3% and 49% respectively which are much higher than our study finding.

CONCLUSION:

Observations of time measured by individuals should help circumvent those issues related to ARV vaccination like registration queue, long waiting time, consultation, actual vaccination and delay in procurement of medicines. The present study makes an attempt to find the pitfalls in the early disposal of patients in the ARV clinic and advocates the staffs of the ARV OPD in smooth management of OPD attendees. Time Motion study actually defines the workflow process and quantifies the time spent on completion of various activities. In healthcare, related activity is aimed to measure the dynamics of staff movement and the utilization of healthcare resources. Health care services should plan to undergo a digital transformation in order to keep pace with the increasing trend of functioning of electronic medical record . The proportion of average time spent on vaccination and consultation relatedactivities and the average time per task should be taken into account after analysis. There should be a significant reduction in proportion of time spent in transit. The proportion of time spent on professional communication, direct care or documentation are to be streamlined. The flow in the workstation will enable them to spend longer with patients per direct care episode at point of care and use their time on other activities more efficiently. There should be distribution of work to exhibit their clinical skills and expertise.

As per the reasons and solutions of the problems encountered, they should have a separate OPD registration counter, Drug disposal *Niramaya*and counselling room. This study can certainly pave the way to the development of National guidelines of time motion of patient management in Indian scenario as well standard operating Protocol in delivery of services in the institutional level.

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