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Research

A Prospective Study on Role of Clinical Pharmacist in Delivering the Clinical Pharmacy Services to the Mother in Pediatric Immunization in a Tertiary Care Hospital

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Abstract

The aim of the study is role of clinical pharmacist in delivering the clinical pharmacy services to the mother in pediatric immunization in a tertiary care hospital for vaccination. It has been observed in the present study that the knowledge of mothers on immunization is very poor in general ranging from 5.3% for DPT to 29.3% for other vaccines except there was a fairly good knowledge on OPV (78%). The rate of immunization was fairly high (95.7%). Participation in Pulse Polio Programme was seen in all the 100% of the children. Although, there was a poor knowledge on immunization, cent percent mothers were having favourable attitude towards immunization. In this study, 68.05% of the mothers were illiterate, among them majority had lack of knowledge on immunization, this might be the factor which has affected poor immunization coverage in this group. The missed opportunities for immunization is observed to be15.8%. We found that out of 164 paediatric population, around 29.63% experienced adverse events following immunization. A description of the characteristics of the adverse reactions presented would show that the great majority were mild in nature (pain, injection – site edema, fever etc). About 63% of the adverse event, were fever and 33% swelling. Adverse events remained mostly for a day.

Keywords: Prospective Study, Clinical Pharmacist, Clinical Pharmacy Services, Tertiary Care Hospital, Vaccination

INTRODUCTION

The advantages of immunization, one of the most practical general wellbeing mediations, have not completely arrived at target recipients in some low-and center pay nations (LMICs).[1] However the field of immunization research and vaccinology has gotten a ton of consideration since the disclosure of the smallpox antibody by Edward Jenner (1749-1823) in 1798, over two centuries after the fact, an expected 20% of passings among youngsters matured under 5 years happen because of sicknesses preventable by right now authorized vaccines.[2,3] "antibody" started from vacca, a Latin expression for the cow.[4] The credit for the main utilization of the expression "immunization" goes to Swiss doctor Louis Odier (1748-1817), and the expressions "inoculation" and "to inoculate" were first utilized by Richard Dunning (1710-1797).[5] The study of disease transmission, which in a real sense signifies "the investigation of what is upon individuals," is gotten from the Greek epi signifying "upon, among," demos signifying "individuals," and logos signifying "study or talk." Doctors from the hours of Hippocrates (460-370 BC) attempted to figure out the example of illnesses locally, however the expression "the study of disease transmission" was first used to portray the investigation of plagues in 1802 by the Spanish doctor Villalba in The study of disease transmission Española.[6]

In current times, John Snow (1813-1858) and William Farr (1807-1883) spearheaded the work on the study of disease transmission and are in many cases alluded as one of the "fathers of present day epidemiology."[7,8] An immunization is "an inactivated or constricted microorganism or a part of a microbe (nucleic corrosive, protein) that when regulated to the host, animates a defensive reaction of the phones in the resistant framework," or it is "a safe natural substance intended to create explicit security against a given disease."[9] An immunization is not quite the same as immunoglobulin in that the antibodies help in creating defensive antibodies in the body of the person to whom these are controlled, and assurance is accessible after a slack time of half a month to a while. Be that as it may, immunoglobulin gives quick security. The antibody organization is trailed by two kinds of resistant reactions: Essential and auxiliary. [10]. The supporter dosages have fast and higher neutralizer reaction, a higher fondness for immunizer creation, and give longer term of insurance (this is connected to optional safe response).[11] The immune response reactions to immunizations are normally distinguished by "the relates of security," an insusceptible reaction that is answerable for and measurably interrelated with assurance and generally connected to B-cell subordinate reaction. However, for various new immunizations, it is expected that White blood cells likewise assume a part in corresponds of security. The corresponds of security are recognized by creature challenge models and adequacy trials.[12]

The aim of the study is role of clinical pharmacist in delivering the clinical pharmacy services to the mother in pediatric immunization in a tertiary care hospital for vaccination. The objectives are to study the awareness among parents on paediatric immunization, to Assess the knowledge of mothers regarding immunization, to Assess the immunization status of the children, to study the mother's attitude and perception towards immunization, to Identify the factors affecting immunization, to Find out the association between the factors affecting the immunization and immunization status of the children.

METHODOLOGY

The study was conducted in a tertiary care teaching hospital (KIMS) at Bangalore in Karnataka.

Source Ofdata: The patients demographical, clinical, and therapeutic data were collected from

- Patients case notes
- Immunization record book
- Patient's parent or guardian's interview

Study Duration: This study was carried out during December 2004 to June 2005.

Studycriteria

Inclusion criteria

- Healthy Neonates, Infants, and children up to 18 years of age.
- Parents/guardians who consented to participate in the study, as respondents

Exclusion criteria

- Above 18 years of age
- Prematurebaby
- Immuno-compromisedchildren
- Malnourishedchildren
- Paediatrics with history of chronic or neurological illness

- Paediatrics whohas received any blood products, high doses of corticosteroids, cytotoxic agents or radiotherapy

Study Design: Descriptive study
Sample Size: 164 children, who attended Immunization center of Paediatric OPD, were studied for adverse reactions following immunization. Of these, a sub sample of mothers were interviewed for parent's awareness on immunization.
Statistical Analysis: The collected data were analyzed for statistical inference by computing proportion, percentages, and also presented in graphical methods.
Ethical approval: The study was approved by the ethical committee.

MATERIALS ANDMETHODS

In the present study 164 children, who attended Immunization center of Paediatric OPD, who have fulfilled the inclusion and exclusion criteria were recruited for the study. Of these 164, a sub sample of 72 mothers with clear address and phone numbers were selected and interviewed for parent's awareness on immunization schedule by using parent's awareness evaluation form.

Study Design: Prospective study
Sample Size: 164 children, who attended Immunization center of Paediatric OPD, were studied for adverse reactions following immunization. Of these, a sub sample of 72 mothers were interviewed for parent's awareness on immunization.
Statistical methods: The collected data's were analyzed for statistical inference by computing proportion, percentages, and also presented in graphical methods.
Ethical approval: The study was approved by the ethical committee.

RESULTS

Table 1: Gender wise categorization

S.NO	GENDER	NO. OF PATIENTS	% NO. OF PATIENTS
1	Male	88	53.65
2	Female	76	46.34

According to our study sample size of children was 164.out of 164 sample size males were identified 88(53.65%), females were identified 76(46.34%). Results were summarized in table 1.

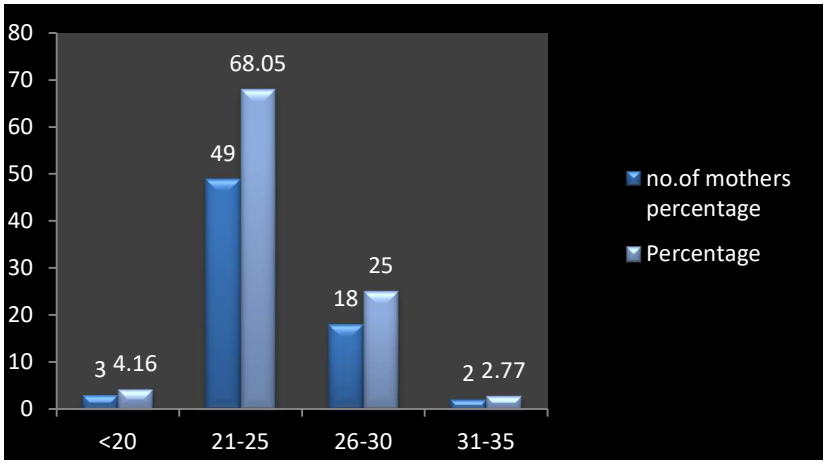

Fig 1: Distribution of age of mother

According to our study sample size of mother counselled were 72.out of 72 <20years age group were 3(4.16%),21-25years age group were 49(68.05%),26-30 years age group were 18(25%), and 31-35 years age group were 2(2.77%). highest number of mothers attended were from age group between 21-25years age group. results were summarized in fig 1.

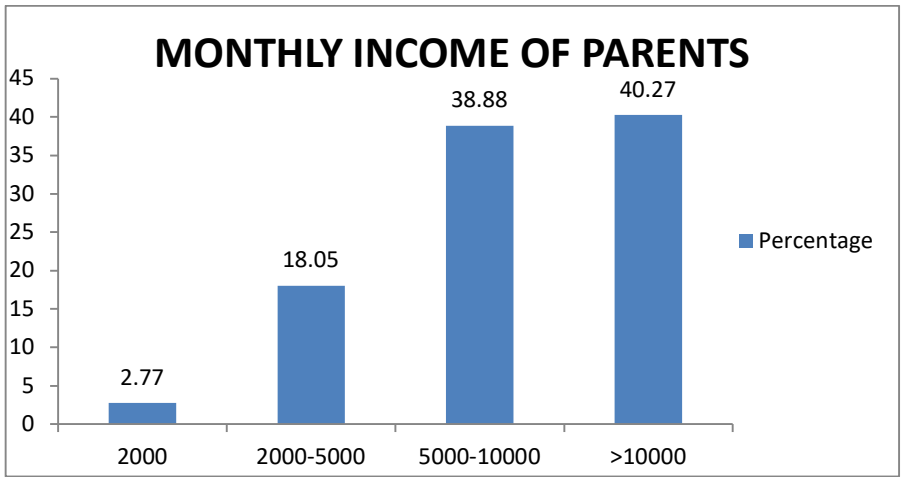

Fig 2: Monthly income of parents

In our study parents who attended for counselling were 72. we have categorized monthly income of the parents. <2000 was 2(2.77%),2000-5000 were 13(18.05%),5000-10000 were 28(38.88%), and>10000 were 29(40.27%). Highest number is found with >10000 income. Results were summarized in fig 2.

Table 2: Type of residence Parents staying

Type of residence	No. of parent	Percentage
Urban	49	68.05
Rural	23	31.94
Total	72	100.0

In our study we included the place where the parents are living. out of 72 members urban 49(68.05%) and rural 23(31.94%) were identified. Results were summarized in table 2.

Table 3: Parent education details

Educational status	Father		Mother	
	No. of subjects	Percent	No. of subjects	Percent
Illiterate	23	31.94	49	68.05
literate	49	68.05	23	31.94
Total	72	100.0	72	100.0

According to our study education status of the parents were done. out of 72 father illiterate 23(31.94%) literate were 49(68.05%) and mother illiterate were 49(68.05%), literate were 23(31.94%).Results were summarized in table 3.

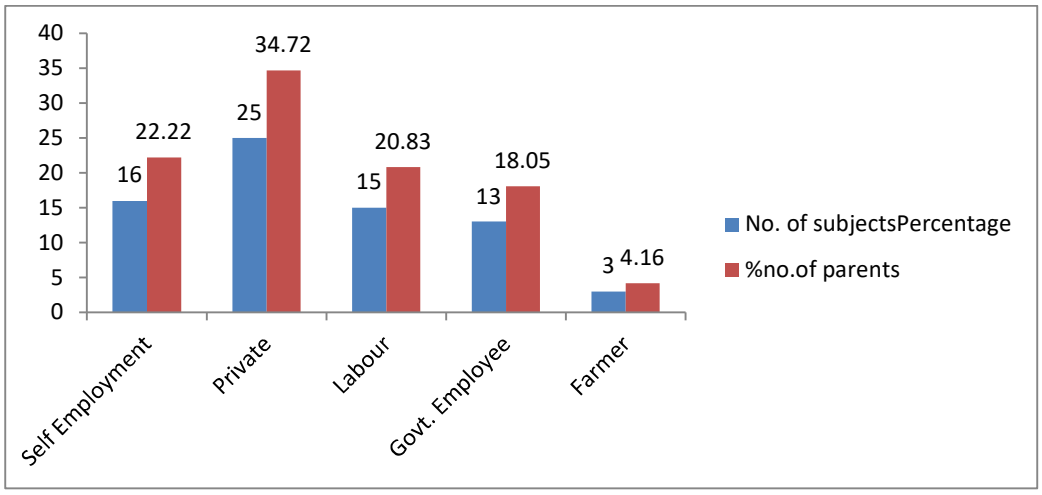

Fig 3: Work status of the Parents

According to our study work status of the parents also included. out of 72 parents father work status self-employment were 16(22.22%), private job was 25(34.72%), labour were 15(20.83%), government employment 13(18.05%), and farmer 03(4.16%). results were summarized in fig 3.

Table 4: Work status of the Parents

Work status	Mother	
	No. of subjects	Percentage
House wife	26	36.11
Self-Employment	14	19.44
Private	22	30.55
Labour	02	2.77
Govt. Employee	08	11.11
Total	72	100

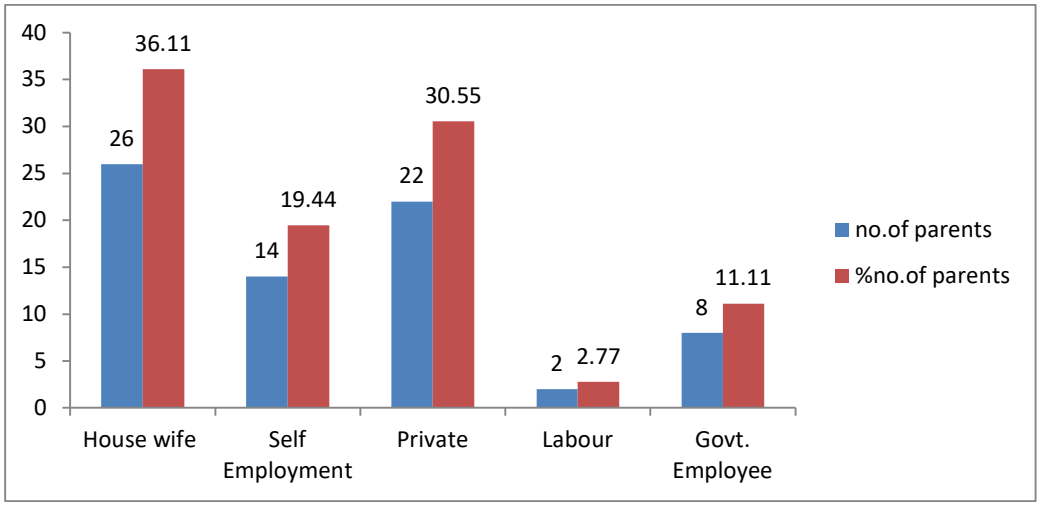

Fig 4: Work status of the Parents

According to our study work status of the parents also included. out of 72 parents mother work status house wife were 26 (36.11%), self-employment were 14(19.44%), private were 22(30.55%),government employment 8(11.11%),and labour 02(2.77%). Results were summarized in fig 4.

Table 5: Classification of type of family

Type	No. of parents	Percentage
Orthodox	19	26.38
Joint	26	36.11
Nuclear	27	37.5
Total	72	100.0

In our study we have done type of family which the parents belong. out of 72 orthodox were 19(26.38%), joint family were 26(36.11%), and nuclear family were 27(37.5%). Results were summarized in table.5.

Table 6: Family history

No. of children	Number	Percentage
1	32	44.44
2	36	50.00
3	04	5.55

In our study family history was included.one children were 32(44.44%), two children were 36(50%), three children were 04(5.55%) results were summarized in table 6.

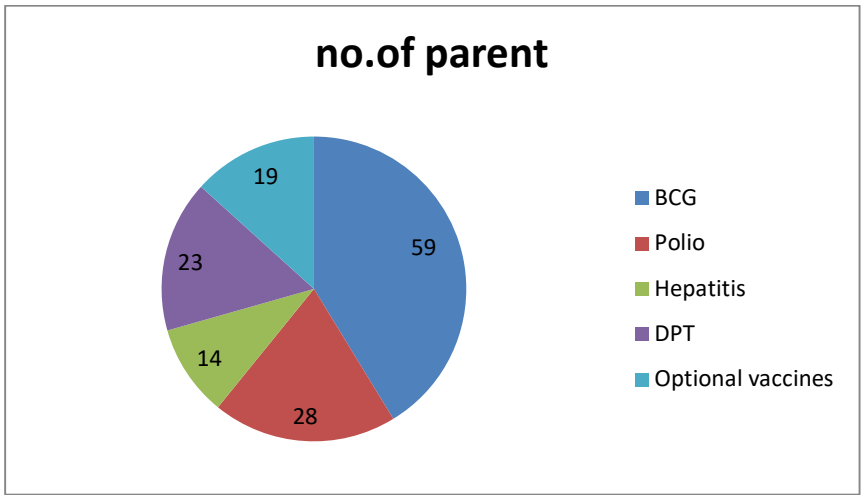

Fig 5: Parent knowledge about immunization

In our study parent knowledge about immunization was include. About BCG vaccine 59 were known, about Polio 28 were known, about hepatitis 14 were known, about DPT 23 were known and about optional vaccines 19 were havingknowledge. results were summarized in fig 5.

Table 7: Status of children immunization

Immunization schedule	No. of parent	Percentage
Followed	69	95.83
Not followed	03	4.16
Total	72	100

In our study we evaluated the status of immunization schedule followed are not by the parent. out of 72 parents schedule followed were 69(95.83%) and not followed were 03(4.16%). Results were summarized in table 7.

Table 8: Type of vaccination according to age wise categorization

Vaccines	Age			Total
	Days	Months	Years	
BCG +OPV +Hep-B	44	3	-	47
DPT + OPV	-	26	2	28
DPT + OPV + Hep – B	-	6	1	7
DPT + OPV + Hib	-	3	2	5
DPT + Hep - B + Hib	-	4	5	9
DPT + Heb – B	-	3	2	5
Measles	-	23	2	25
Measles + Hib	-	4	1	5
Measles + MMR+ Hep – B	-	1	3	4
MMR	-	8	4	12
MMR + Hib	-	2	1	3
Hep-B	-	5	-	5
Chicken pox	-	2	3	5
Hib	-	-	2	2
Hib + Hep – B	-	-	1	1
Typhoid	-	-	1	1
Total	44	90	30	164

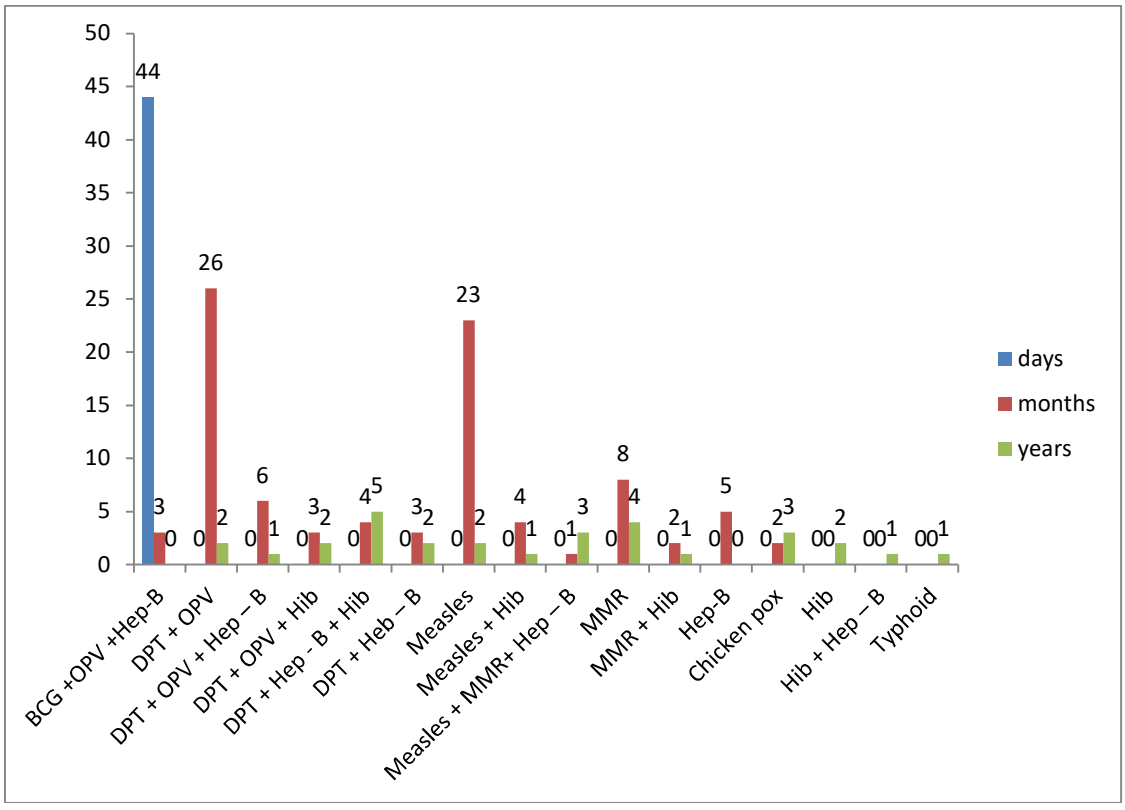

Fig 6: Type of vaccination according to age wise categorization

In our study 164 children received vaccination. out of 164 days were 44(26.82 %), months were 90(54.87%), and years were 30(18.29%). Results were summarized in table.8 and fig 6.

Table 9: Adverse drug reactions identified after vaccination

Name of Vaccine	Adverse drug reaction after vaccination								
	Fever	Increase appetite	fatigue	Vomiting	Redness at site of injection	Swelling at site of injection	Pain	Convulsion	Persistent Crying
BCG +OPV +Hep-B	6	3	1		2	3	6	-	2
DPT + OPV	7	2	-	-	5	6	9	-	5
DPT + OPV + Hep - B	18	1	-	-	1	5	2	-	-
DPT + OPV + Hib	4	1	-	3	-	3	3	-	1
DPT + Hep - B + Hib	13	-	-	-	2	-		-	-
DPT + Heb - B	2	2	-	-	-	-	4	-	-
Measles	6	-	3	-	1	-	-	-	2
Measles + Hib	1	3	-	-	-	4	3	-	-
Measles + MMR+ Hep - B	5	-	-	2	-	-	1	3	-
MMR	-	4	-	-	3	-	-	-	-
MMR + Hib	-	-	-	-	-	1	-	-	3
Hep-B	-	-	2	1	-	-	-	-	-
Chicken pox	-	-	-	-	-	3	1	-	-
Hib	-	-	-	-	-	-	3	-	-
Hib + Hep - B	1	-	-	-	1	-	-	-	-
Typhoid	-	-	-	-	2	-	2	-	1
Total	63	16	6	6	17	25	3	3	14

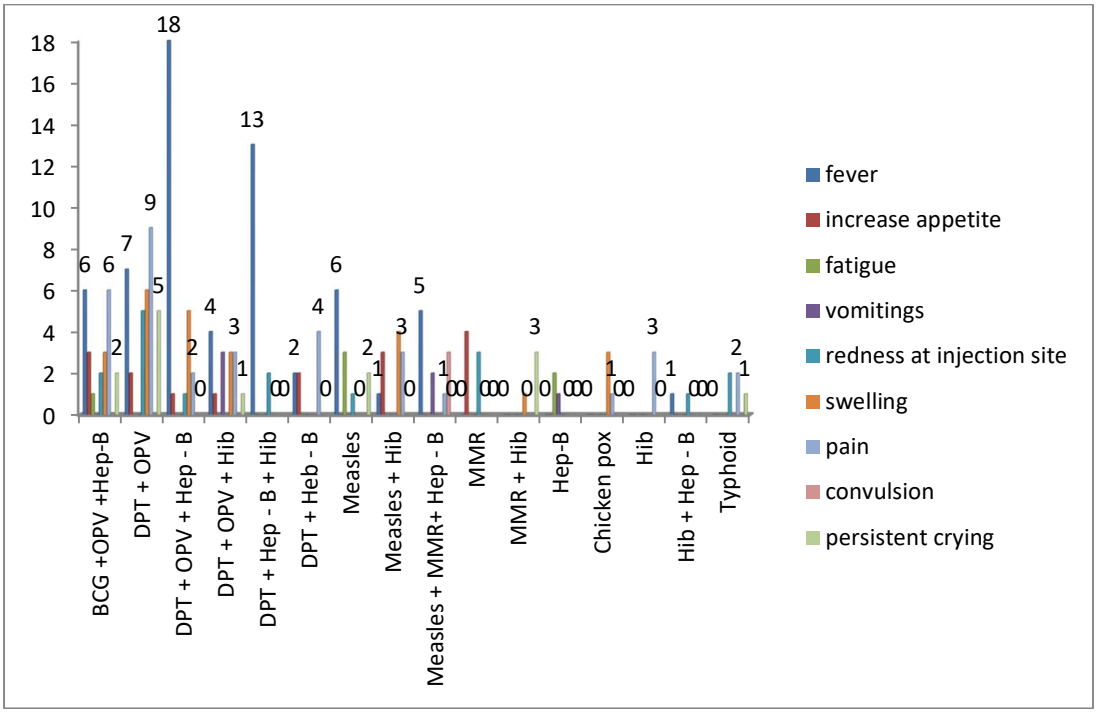

Fig 7: Adverse drug reactions identified after vaccination

In our study we have identified the adverse reactions after immunization. Out of the 164-sample size, around 83(50.60%) children were identified with adverse reactions after the immunization. DPT + OPV + Hep - B vaccine caused a greater number of adverse reactions than any other vaccine. Most of the adverse reactions were fever and pain.

Table 10: Type of adverse drug reaction

S.NO	Adverse reactions	Number of patients
1)	Fever	63
2)	Increase appetite	16
3)	fatigue	6
4)	Vomiting	6
5)	Redness	17
6)	Swelling	25
7)	Pain	33
8)	Convulsion	3
9)	Persistent crying	14

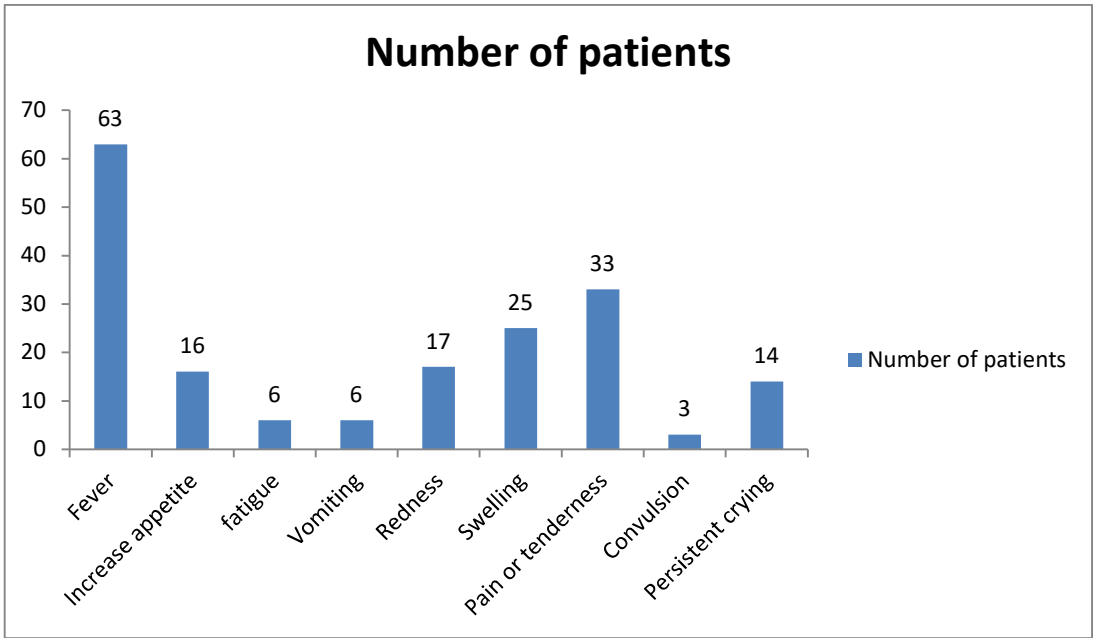

Fig 8: Type of adverse drug reaction

In our study part of clinical pharmacy services, we have identified the adverse reactions after immunization. fever were 63, increased appetite were 16, fatigue were 6, vomiting were 6,redness at the site of vaccination 6, swelling at the site of vaccination 17,pain at the site of injection 33,convulsion were 3,persistent crying were 14 identified. results were summarized in table.14. and figure.15.

Table 11: Patients admitted in hospital due to severe reaction after immunization

Vaccines	Number of children	Percentage
DPT + OPV	7	4.26
Measles + Hib	4	2.43

In our study out of 164 few children admitted in hospital due to severe adverse reaction after immunization. The ssevere adverse reaction is found with DPT+OPV and measles + HIB vaccination. DPT+OPV were 7(4.26%) and measles +HIB were 4(2.43%). Results were summarized in table .15 and figure .16.

Table 12: Medication given in home after the adverse reaction

Name of the Vaccines	Medication given
BCG +OPV +Hep-B	6

DPT + OPV	7
DPT + OPV + Hep - B	18
DPT + OPV + Hib	4
DPT + Hep - B	13
Measles + Hib	2
Hib + Hep - B	6
Typhoid	1

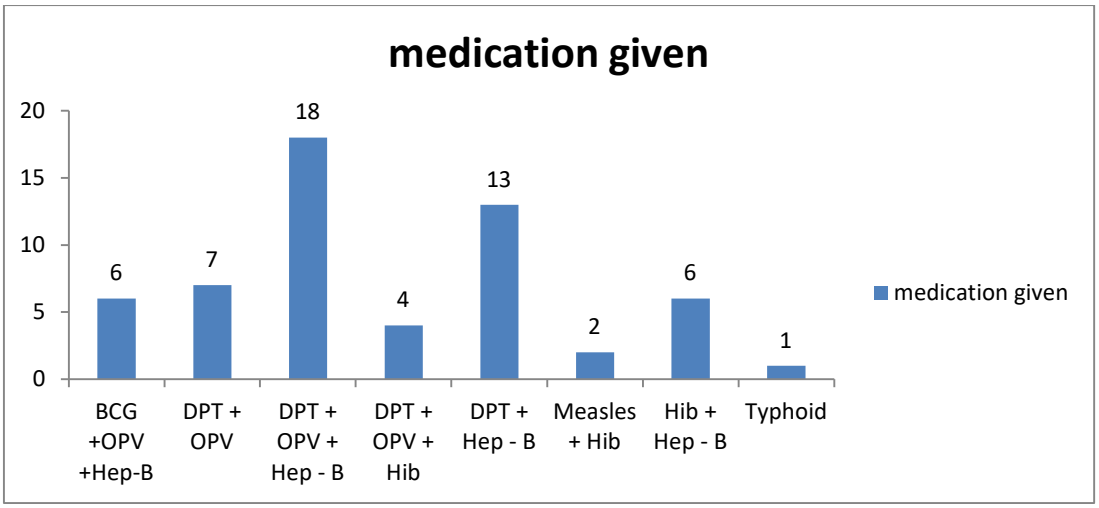

Fig 9: Medication given in home after the adverse reaction

In our study out of 164 children some are treated with medication in home itself after identifying the adverse reaction with immunization. BCG +OPV +HEP-B were 6, DPT + OPV were 7, DPT + OPV + Hep - B were 18, DPT + OPV + HIb were 4, DPT + HEP-B were 13, measles+HIB 2, HIB+HEP-B were 6, typhoidwas1. Results were summarized in table.16 and figure.17.

DISCUSSION

Mothers play a strongly influential role in the vaccination of their children. It is therefore important to ensure that public health interventions for promoting childhood vaccination address maternal concerns and barriers.Fetal have observed that level of knowledge about mandatory vaccination of infants, is correlated with the mother's age and level of education. Lower education level of parents may be associated with non-adherence to vaccination.

Mothers participated in our study are mostly young mothers of an age between 20-25 years. A salary of Rs 2000/- indicates that the participants are from low-income group. Mothers were mostly housewives and some fathers were in a low-paid job like plumbers, auto-driver, labour, farmer etc. Educationally, most of them were literate father parent and illiterate mother .most of them from urban city.

Mothers were mostly young and live either in a nuclear or joint family. Most of them had only one child.In the present study,it was observed that 76% of the parents knew about polio vaccination and all the parents(100%)had participated in pulse polio program.

This data has been consistent with result of many studies, namely WHO,polio eradication drive,Intensive pulse polio education campaign by using mass media like TV, radio, home visit etc have been initiated. Pulse polio immunization coverage has been excellent.

Hence the participation of the parents in polio immunization continues to be very promising. But the knowledge about polio disease and vaccines is not as much as the polio vaccination compliance percentage. Hence there is a need to create awareness about the poliomyelitis disease and the effects of poliomyelitis disease, and the need for vaccination along with vaccination drive. Knowledge is proportional to education and other socio economic factors.Measles,Mumps,Tuberculosis,Hepatitis etc are equally life threatening.But it was noticed that knowledge about DPT was hardly 6.3% whereas knowledge about BCG 26%. None of them were aware about measles and MMR,though these vaccinations are essential part of national immunization schedule. Hence strategies used for Pulse Polio Program can be effectively utilized for coverage of other vaccinations such as Measles, MMR, DPT, Hib and Hep-B.A study among Italian mothers by Angelillo IF et al shows that mothers

knew most of the mandatory vaccines and this knowledge was significantly greater among those with higher education level and older at the time of the child's birth.Lacks of information, in addition to mothers' illiteracy and inaccessibility to the immunization center have been reported to contribute to low levels of immunization.

In spite of lack of knowledge, 95.83% of parents have followed immunization schedule for their children. About 4.16% of parents have not followed the schedule. Most of the parents not followed the schedule were illiterate. The source of information was mostly doctoring(94.56%).

Parents and Health workers had also played an important role in informing them about vaccination schedule. We understood from the awareness evaluation that the awareness level was low, but the vaccination compliance level was high. This may be because the awareness source is basically doctors who ensures immunization, but may not have time for education. Complying with the immunization schedule without an appropriate education will not ensure the continuity of the compliance to the schedule in the absence of a medical practitioner.

In a nation like India, where the ratio of the patient to the doctor is low in the rural places, non-compliance rate may increase in the absence of education and hence there is a need for education. Clinical pharmacist has to develop immunization educational materials and technology to impart the needed vaccination education and help in improving the immunization knowledge base and compliance. The incidence rate of measles declined from 6.8% reported in the baseline to 3.5% in the impact assessment of mass measles vaccination campaign.The vaccination coverage had improved following the campaign.

Government should take initiative in creating awareness to the public through effective use of mass media, mass vaccination campaigns repeatedly. Information, Education & communication is urgently needed in the area of immunization program especially to the under-privilege groups and areas such as slum in cities so that target of universal coverage can be achieved.

Reasons for noncompliance with or non-delivery of vaccinations to eligible children on schedules and the factors that may affect immunization rates need to be identified and addressed in order to prevent these diseases. Promotion of formal education for girls and educating mothers and health workers on the timing of vaccinations, their side effects, and management might contribute to higher vaccination coverage.

In our study, 9.3% of the children had not followed the immunization schedule whereas 14% had missed opportunities. A paramedic could screen the children attending the health facilities and refer the eligible children for immunization. For an effective screening system, the importance of retaining immunization cards and bringing them at each health care visit has to be emphasized to the mothers by the health workers at all levels.

The present study shows that only 83% of the mothers' maintained immunization record book during the first child immunization, whereas 95% of the mothers maintained the immunization record book during the 2nd child immunization, and 60% maintained for third child.Most of them are giving reasons such as lost while shifting the house, missed somewhere and not bothered to search etc which indicate that mothers are not keen to maintain immunization record book.

Meera et al observed that avoiding missed opportunities could be an effective and inexpensive tool to improve measles immunization coverage.

Our study indicated that mothers who had missed the schedule were giving reasons like no knowledge about immunization, child was sick at the schedule time, shifting of house, were lazy, forgot, etc for non-immunization. We found that mothers were unable to name the vaccines other than oral polio. This emphasis the urgent need for an education on immunization focused in communicating to illiterate poor mother.

Lack of information was observed as one of the main reasons for non- immunization for most of the vaccines especially in Bihar and Rajasthan. Lack of motivation, and obstacles such as child ill, mother is too busy, vaccinator absent, illness of mother, place of immunization too far, inconvenience of time, vaccine not available, long waiting time etc are also contribute to non- immunization for vaccines.[23]

Manjunath and pareek reported that, though majority expressed favorableattitudes and were satisfied with the program, mother's inability to name or identify diseases other than poliomyelitis indicates that health education should be emphasized to enhance mother's knowledge about the complete program. The study also reported a drop out rate of 21.2 % from DPT1/OPV1 to DPT3/OPV3 and 34.9% drop out rate from DPT1/OPV1 to measles vaccine. [3]The vaccination-missed cases in ourstudywere after 5 months schedule (like Measles, MMR, Booster doses).Out of the 164 babies participated, around (29.63%) experienced adverse events following immunization. Of that around 63 of the adverse reaction was fever whereas only 33 was pain at the injection site.

Although most vaccines can induce some type of adverse reaction, such reactions are seldom viewed as serious. This finding correlates with the study conducted by Pilar carrasco who recorded that of the sample of 946 children, 191 non-serious suspected adverse reactions were detected representing, 19% of the vaccinated children. But in our study, we found more percentage (28%) of the vaccinated children experienced adverse reactions.

A description of the characteristics of the adverse reactions presented would show that the great majority were mild in nature (pain, injection-site edema, etc) as is normally the case with systemically applied vaccines. Similarly, the types of adverse reactions observed in this study did not differ widely from the usual reactions reported by the US Vaccine Adverse Events Reporting System in what, over a 10 years surveillance period,

symptoms such as fever, injection site edema and injection site pain emerged as the most frequent vaccine reactions. Any attempt to identify vaccines implicated in the above-mentioned adverse reactions usually leads to the determination of vaccines that are prone to provokesome of these reactions as a result of their components. In our case, the DPT and Hib vaccine would seem to be implicated in a greater number of adverse reactions.

After identifying the vaccines responsible for adverse reactions and the characteristics of the reactions registered in our population, we continue to regard vaccines are safe biological products. Patients should be informed about the risk and benefits of vaccinations including its side effects, adverse reactions, and in case any, how to manage it or which type of adverse reaction requires immediate medical attention.Active search systems for adverse reactions to vaccines in a primary-care setting are a good method for detecting and quantifying those reactions that, owing to their mild nature, tend not to be reported by passive surveillance systems.

CONCLUSION

It has been observed in the present study that the knowledge of mothers on immunization is very poor in general ranging from 5.3% for DPT to 29.3% for other vaccines except there was a fairly good knowledge on OPV (78%). The rate of immunization was fairly high (95.7%). Participation in Pulse Polio Programme was seen in all the 100% of the children. Although, there was a poor knowledge on immunization, cent percent mothers were having favourable attitude towards immunization. In this study, 68.05% of the mothers were illiterate, among them majority had lack of knowledge on immunization, this might be the factor which has affected poor immunization coverage in this group. The missed opportunities for immunization is observed to be15.8%. We found that out of 164 paediatric population, around 29.63% experienced adverse events following immunization. A description of the characteristics of the adverse reactions presented would show that the great majority were mild in nature (pain, injection – site edema, fever etc). About 63% of the adverse event, were fever and 33% swelling. Adverse events remained mostly for a day.

REFERENCES

1. World Health Organization. State of the World's Vaccines and Immunization. World Health Organization (WHO), UNICEF, World Bank. 2009:5–210. [Google Scholar]
2. Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, et al. Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality in 2008: A systematic analysis. Lancet. 2010;375:1969–87. [PubMed] [Google Scholar]
3. Lahariya C. A brief history of vaccines and vaccination in India. Indian J Med Res. 2014;139:491–511. [PMC free article] [PubMed] [Google Scholar]
4. Bailey I. Edward Jenner (1749-1823): Naturalist, scientist, country doctor, benefactor to mankind. J Med Biogr. 1996;4:63–70. [PubMed] [Google Scholar]
5. Bhattacharya S, Harrison M, Worboys M. Fractured States: Smallpox, Public Health and Vaccination Policy in British India. Hyderabad: Orient Longman; 2006. pp. 18–23. [Google Scholar]
6. Morabia A. A History of Epidemiologic Methods and Concepts. Basel: Birkhauser Verlag; 2004. p. 346. [Google Scholar]
7. University of California at Los Angeles (UCLA). Father of Modern Epidemiology. Vol. 16. Los Angeles: University of California at Los Angeles (UCLA); 2005. pp. 8–10. [Google Scholar]
8. Lilienfield DE. Celebration: William Farr (1807-1883)-an appreciation on the 200 th anniversary of his birth. Int J Epidemiol. 2007;36:985–7. [Google Scholar]
9. Plotkin SA, Orenstein W, Offit PA. Vaccines. 6th ed. Philadelphia: Saunders; 2013. pp.1141–96. [Google Scholar]
10. Seigrest C. In: Vaccine immunology. 6th ed. Plotkins SA, Orenstein W, Offit PA, editors. Vaccines. Philadelphia: Saunders; 2013. pp. 14–32. [Google Scholar]
11. Paoletti LC, Rench MA, Kasper DL, Molrine D, Ambrosino D, Baker CJ. Effects of alum adjuvant or a booster dose on immunogenicity during clinical trials of group B streptococcal type iii conjugate vaccines. Infect Immun. 2001;69:6696–701. [PMC free article] [PubMed] [Google Scholar]
12. Bhatt K, Verma S, Ellner JJ, Salgame P. Quest for correlates of protection against tuberculosis. Clin Vaccine Immunol. 2015;22:258–66. [PMC free article] [PubMed] [Google Scholar]