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ORIGINAL RESEARCH

Trend and assessment of vaccine wastage at an immunisation clinic of newly established tertiary care centre: A record based descriptive study

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ABSTRACT

Background: One of the largest impediments of efficient immunization is the wastage of vaccines. Monitoring of vaccine wastage helps to improve vaccine forecasting and minimize wastage. As the costs of vaccination increases, better vaccine management is essential.

Methods: Conducted a record based descriptive study and the details of all the vaccine vials issued and details of the children who received vaccines from immunisation clinic were captured from August 31st 2021 to July 31st 2023 by universal sampling technique at tertiary care centre AIIMS, Bibinagar, Hyderabad.

Results: A total of 1474 vaccination given to under 5 children and found that vaccine wastage rate of BCG is the highest (80.45%) followed by MR (68.37%), IPV (67.63%) and DPT (64.44%).Lyophilised vaccine has highest wastage rate 74.9% followed by Reuse types (open vial) is 74.9% and least is vaccine with oral route of administration is 45.45%.

Conclusion: This study has generated evidence for enhanced policy decisions and generated recommendations that have been helpful in strengthening the immunization supply chain system in a holistic manner.

Key words: Vaccination, immunization, vaccine wastage, trends in vaccination, descriptive study

INTRODUCTION

Vaccination is a cost-effective and life-saving intervention. Therefore, Universal Immunization Programme (UIP) is one of the important immunization programmes in the world, which covers 26 million (2.6 crores) infants and 29 million (2.9 crores) pregnant women via 12 million (1.2 crores) routine immunization sessions annually. Currently, 12 vaccines (10 nationally, 2 sub nationally) are available in free of cost to the community under UIP [1]. India has the largest birth cohort with 27 million children born, but contrastingly only 44% receiving full schedule of vaccinations as reported in year 2013 [2]. Vaccine wastage is defined by the World Health Organization (WHO) as “loss by use, decay, erosion, or leakage or through wastefulness”, and can be calculated as the proportion of vaccine administered 6 against vaccine issued. Vaccine wastage divided into two types: wastage in unopened vials and wastage in opened vials [3]. Unopened vial wastage is due to inefficiencies in the supply chain, such as temperature control, temperature monitoring, and stock management during storage and transportation. It may result from vaccine expiry, excess heat exposure, freezing, breakage, missing inventory or discard following outreach sessions etc. opened vial wastage can be both avoidable (attributable to immunization workers' practices and include errors in reconstitution, suspected contamination, patients' reaction, excess heat, freezing or breakage) and unavoidable (discarded doses from vials of unused doses of multidose vials and determined by vial size, session size and discard time). It is measured at the level of service delivery or last Cold Chain point (CCPs) [4]. The Government of India have recommended the wastage rate for 50% (BCG), 25% (Measles, Measles and rubella, rotavirus, and Japanese Encephalitis vaccines), and 10% for all other multi-dose vial

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vaccines including DPT, LPV, IPV, OPV, TT, and HBV [5]. Vaccine wastage is an important factor in forecasting vaccine needs. In the absence of local or national data on wastage rates, the country concerned may face serious vaccine shortages or be unable to consume received quantities, leading to increased wastage through expiry [6]. Nearly 43% of vaccines delivered to the developing countries were wasted, largely due to poor infrastructure. And factors such as poor monitoring and tracking of vaccination programs, concerns about vaccine safety, accessibility of health facilities especially in hard-to-reach communities, waiting time at health facilities, low educational level of the local population including both residents and health workers, population density, and logistical challenges in conducting vaccination programs also contributed to vaccine wastage in both rural and urban settings [7]. Evidence from various studies, the vaccines are generally expensive commodities that should be used efficiently to maximize the benefits and minimize wastage to ensure the immunization program sustainability [8]. Newly established tertiary care hospitals face certain challenges in decreasing the vaccine wastage rates [9]. Knowing the wastage rate helps in assessing vaccine wastage and relative magnitude of its various causes which help to target efforts to reduce these losses and to increase funds for increasingly expensive vaccines. There is lack of evidence regarding vaccine wastage at tertiary care centre in India and few studies are found that vaccine wastage rate is more than the recommended/permissible rate [10]. Hence, we conducted the present study with the following objectives:

1. To determine the wastage rate of vaccines in National Immunisation Schedule (NIS) at an immunisation clinic of newly established tertiary care centre.
2. To assess the trends in wastage rate of vaccines in NIS at an immunisation clinic of newly established tertiary care centre

Methodology

This study was a record based descriptive study and universal sampling technique was followed. A total of 1474 vaccinations are given in study period. The details of all the vaccine vials issued and details of the children who received vaccines from immunisation clinic were captured from August 31st 2021 to July 31st 2023.BCG, OPV, Hepatitis B, Pentavalent, DPT, IPV, MR, JE, RVV, PCV, dT and TT - were being given as per NIS. A vaccine stock register and beneficiary register is maintained in immunisation clinic. Date of issue of vaccine vial was captured from vaccine stock register. Number of children who received the corresponding vaccine was obtained from beneficiary register.

Vaccine wastage was calculated using the below formula:

Number of doses wasted = (Number of doses issued - Number of children vaccinated)

Vaccine wastage rate = (Number of doses wasted/Number of doses issued) x 100

Vaccine wastage factor = 100/100-vaccine wastage rate

The data recorded in the registers was entered into Microsoft Excel 2017 and used for analysis using SPSS 21. Risk factors that were assessed included whether the vaccine is of open vial or closed vial type, single vial or multi-vial dose, mode of administration of vaccine (oral/injectable), type of vaccine-lyophilised form /liquid formulation, date of starting of labour room services, effect of COVID second and third wave and expired vaccines.

Results

The vaccine wastage rate and wastage factor are calculated based on all vaccines are given at tertiary care centre. Current study found that vaccine wastage rate of BCG is the highest (80.45%) followed by MR (68.37%), IPV (67.63%) and DPT (64.44%). Wastage factor for different vaccines were calculated show in below table 1. Regarding associated factors, lyophilised (74.9%) and Reuse types (open vial) (74.9%) vaccines are wasting more compare with other factors like vial size, route of administration and frequency of administrations. Results are compared with various studies from India in table.3 showed that almost all vaccine wastage rate is higher than other studies, except Hep B (Vikas Gupta et al). And table.4 is showing that vaccine wastage rate and wastage factor before and after labour room start. BCG (75.8%) and OPV (71%) vaccines wastage rates are increases after labour room start and other vaccine like Hep B, Penta, PCV, MR, JE, DPT, IPV and DT decreases. Emergency situations like COVID, in first and second wave lockdown – Immunization clinic not functional and May 12 – June 19 2021 Second wave lockdown in Telangana.

Table 1: Wastage rate and wastage factor (WF) for different vaccines

S. No.	Vaccine	Total number of doses	Children vaccinated	Wastage rate	Wastage Factor
1.	BCG	440	96	80.45%	5.11
2.	Hep B	140	101	27.85%	1.38
3.	OPV	660	360	45.45%	1.83
4.	Pentavalent	310	214	30.96%	1.44
5.	IPV	550	178	67.63%	3.08
6.	PCV	190	187	1.57%	1.01

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7.	MR	370	117	68.37%	3.16
8.	JE	135	106	21.48%	1.27
9.	DPT	180	64	64.44%	2.81
10.	DT	150	51	34%	1.51

Table 2: Wastage across type/form of vaccines

S. No.	Type/Form	Wastage rate	Wastage factor
1.	**Type of Vaccine**		
	Lyophilised	74.9%	3.9
	Liquid	45.5%	1.8
2.	**Vial Size**		
	5 doses	58.9%	2.4
	10 doses	57.7%	2.3
3.	**Route of administration**		
	Oral	45.45%	1.8
	Injectable	59.2%	2.4
4.	**Frequency of administration**		
	Single dose	67.7%	3.0
	Multi-dose	49.8%	1.9
5.	**Reuse type**		
	Open vial	74.9%	3.9
	Single use vial	45.5%	1.8

Table 3: Vaccine wastage rates reported from India

Author	Wastage rates for vaccine									
	BCG	**Hep B**	**OPV**	**Pentavalent**	**IPV**	**PCV**	**MR**	**JE**	**DPT**	**DT**
Present study	80.45%	27.85%	45.45%	30.96%	67.63%	1.57%	68.37%	21.48%	64.44%	34%
Tiwari et al	20.71%	10.56%	14.65%	5.2%	10.49%	-	-	-	15.6%	-
C Dutta Gupta et al	64.49%	-	41.41%	24.52%	-	-	-	-	-	-
D R Paramar et al	22.93%	6.70%	6.50%	-	-	-	-	-	3.49%	-
Vikas Gupta et al	77.90%	38.66%	28.97%	7.42%	-	-	-	-	46.75%	-
P Daya A et al	-	5.3%	2.4%	0	-	-	-	-	8.4%	-

Table 4: vaccine wastage rate and wastage factor before and after labour room start at newly established tertiary care centre

Vaccine	Before start of labour room		After start of labour room	
	Wastage rate	**Wastage factor**	**Wastage rate**	**Wastage factor**
BCG	59.1	2.4	75.8	4.3
OPV	70.7	3.4	71	1.4
Hep -B	65	2.8	21.6	1.2
Pentavalent	58	2.3	5.6	1.0
DPT	74	3.8	52.5	2.1
IPV	85.6	6.9	46	1.8
MR	73.3	3.7	73.6	3.7
JE	41.4	1.7	0	0
PCV	5	1	0	0
DT	66.6	2.9	65	2.8

Trends in vaccine wastage

Figure1 shows, Trends in vaccine wastage of all available vaccines at AIIMS Bibinagar is assessed from December 2021 to July 2023. In each figure contains Y axis – Number of dosages wasted, X axis- Duration of study in months and dark line, linear line

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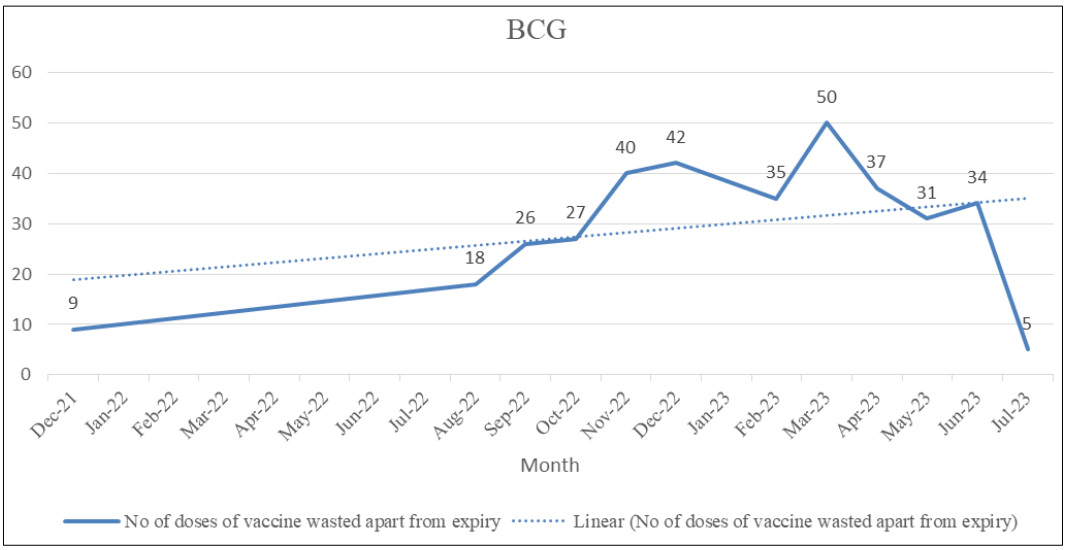
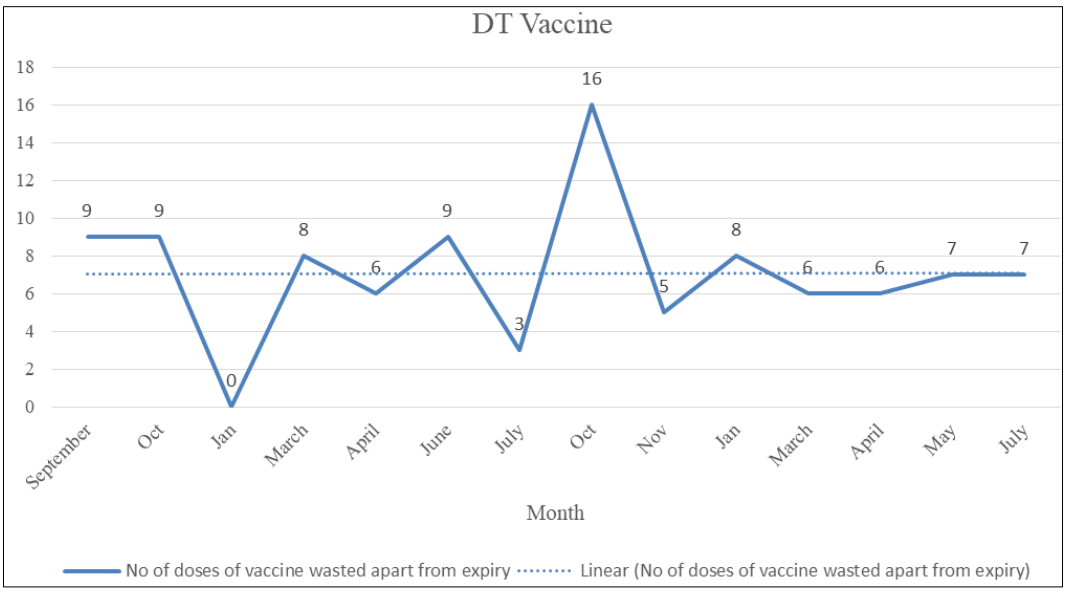
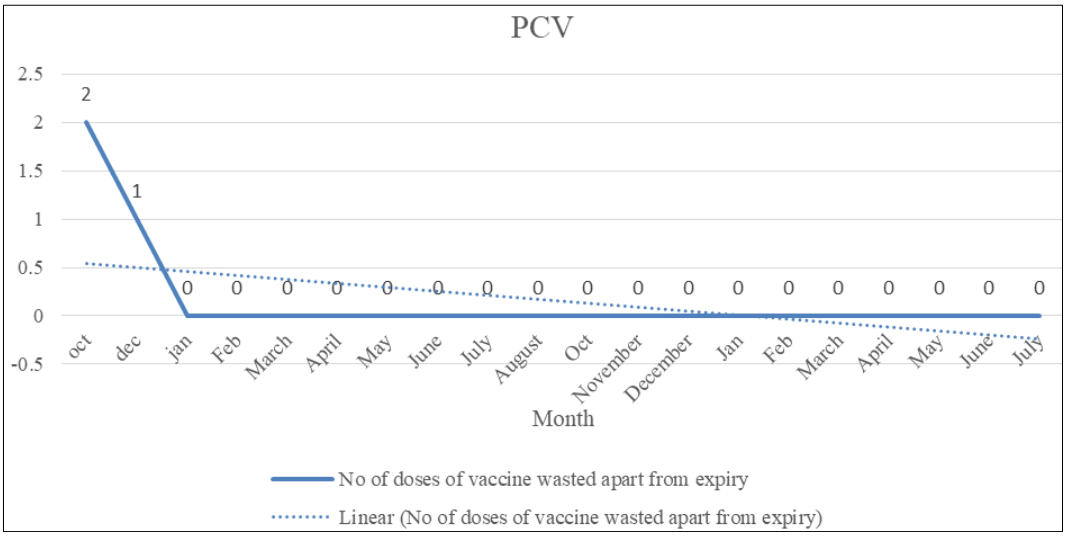
is Trends in vaccine wasted with number of doses of vaccine wasted apart from expiry. BCG vaccine wastage trend from dec2021, gradually increases till dec2022, after than decreases and rapid increases in March 2023. And other vaccines like DT, PCV, DPT, Hep B, IPV, OPV, Penta, MR and JE wastage trends can see in bellow.







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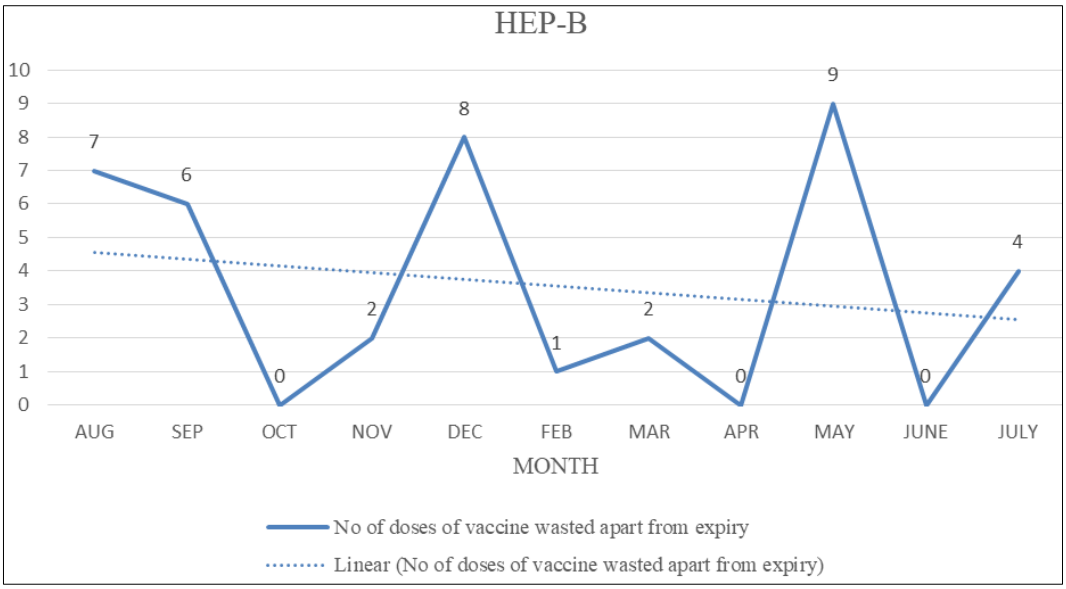

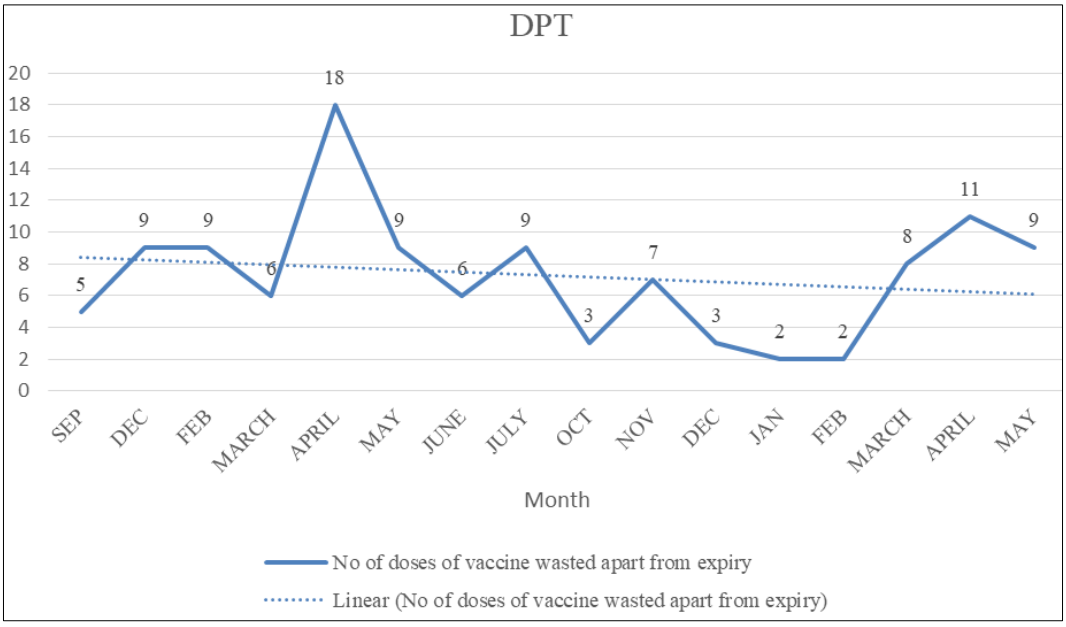

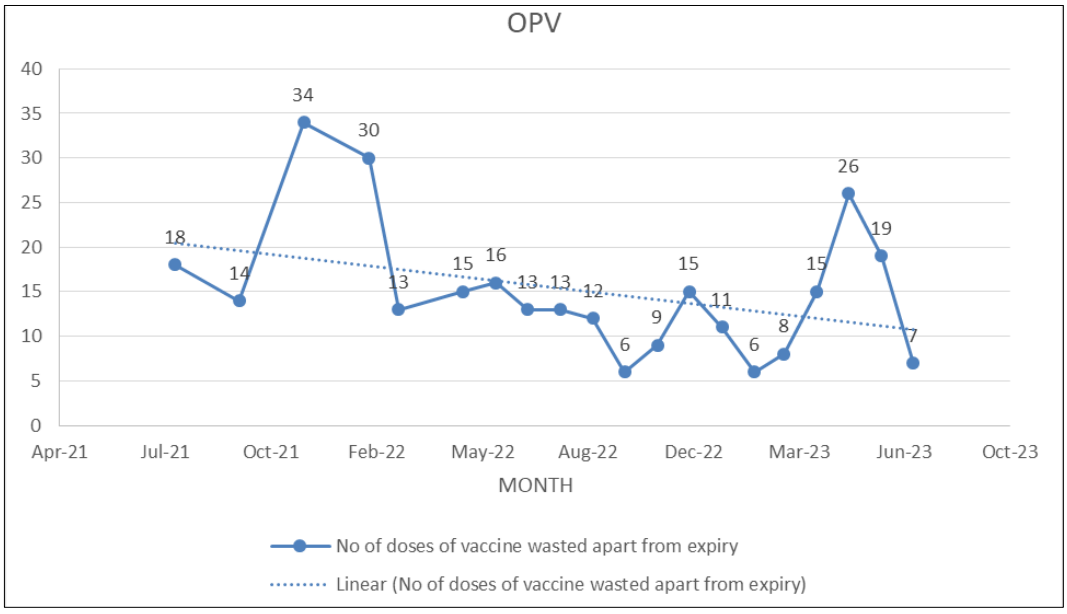

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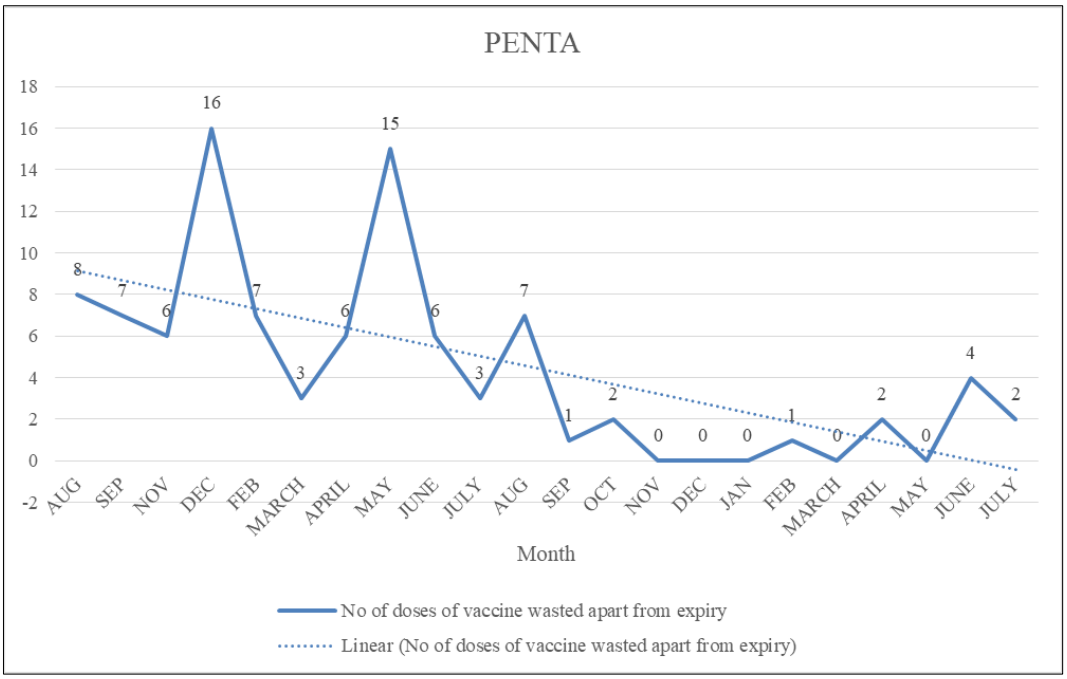

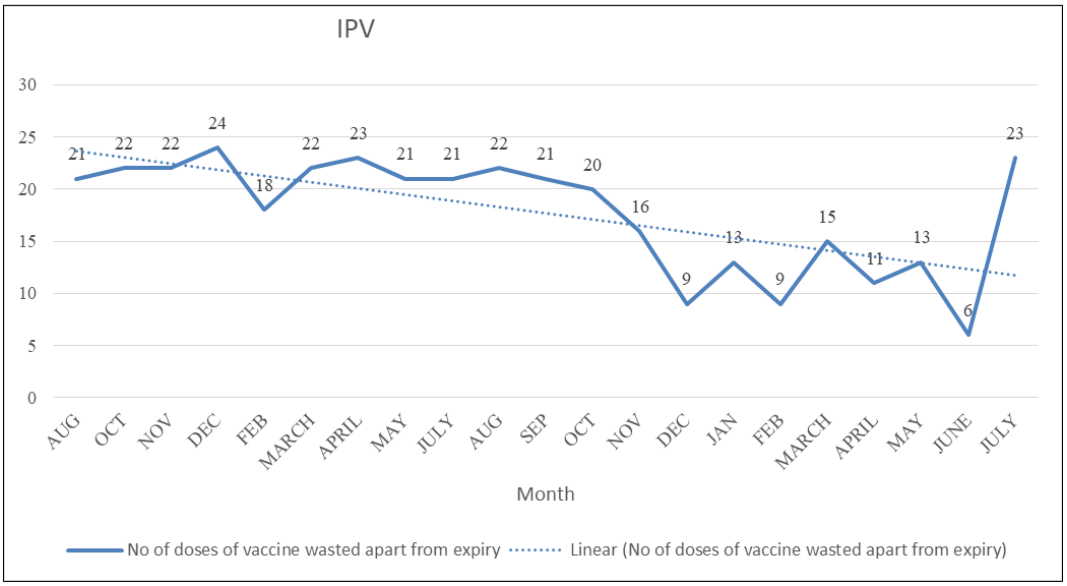

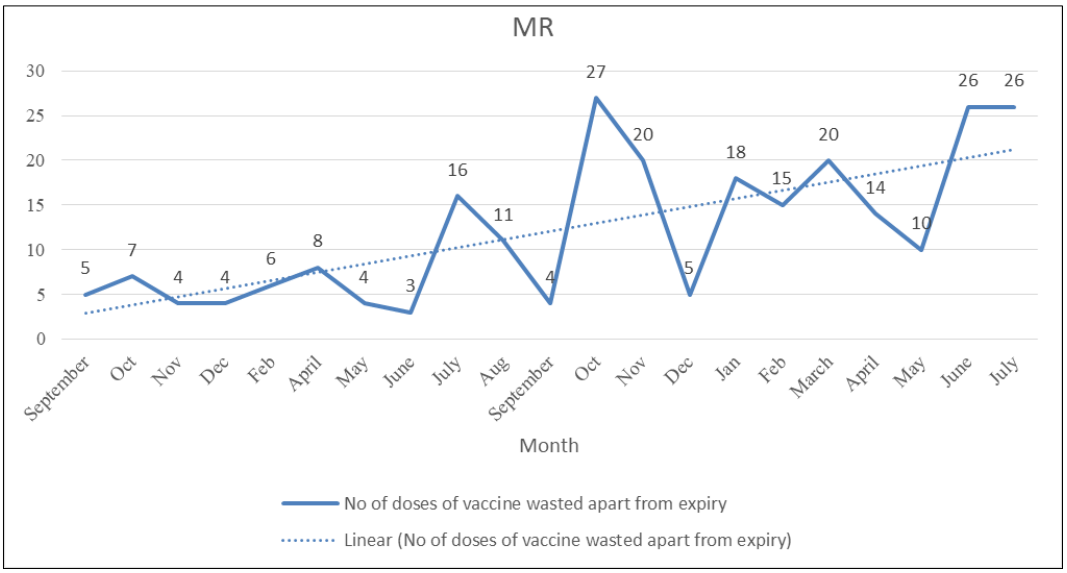

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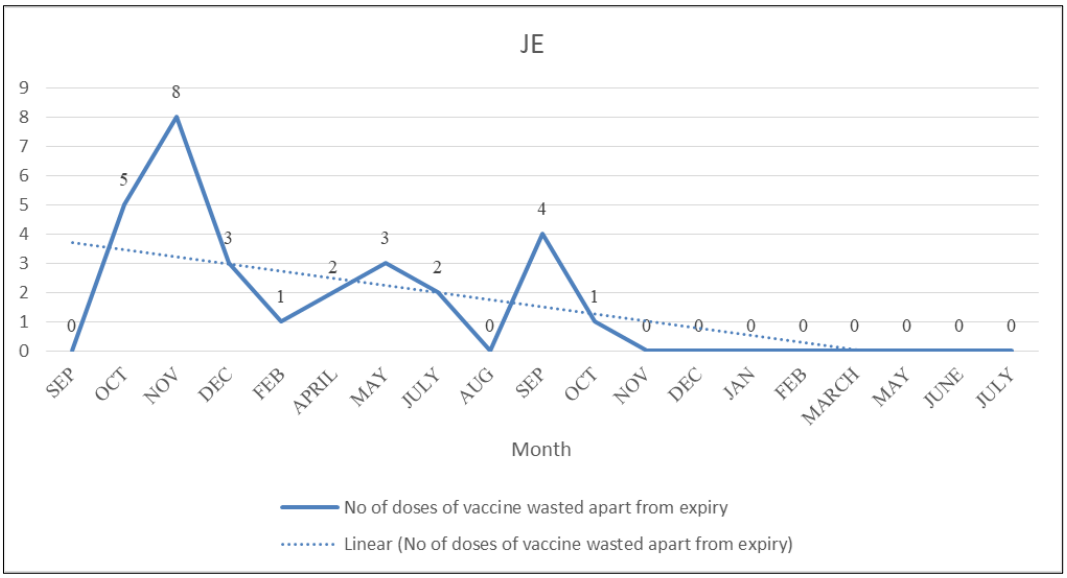

Fig 1: Trends in wastage of all available vaccines at newly established tertiary care centre, AIIMS, Bibinagar, Hyderabad

Discussion

Current study found that vaccine wastage factor for BCG is 5.1, IPV 3.0, MR 3.1DPT 2.81. A study from Delhi [5] wastage factor for vaccines of 10 dose preparations (BCG, DPT, DT and TT) was 2.0, highest for BCG (3.4) and lowest for DPT (1.6) and vaccines of 5 dose preparations (MR), the wastage factor was 1.6. Our study showed higher wastage factor than Delhi study due to various factors like OBG, paediatrics departments are not fully established, rural area and COVID first and second wave. Wastage rate for lyophilised vaccine (74.9%) and Reuse types (open vial) (74.9%) followed by single dose (67.7%), injectable (59.2%), and minimal wastage is oral route vaccine (45.5%) because of lack of training, short duration of expiry, lack of proper equipment, storage factor, improper monitoring and evaluation at immunization centre. After extended search, there is only few studies on trends in vaccination in India. BCG, MR vaccines are gradually increases in 2022 due to covid pandemic, proper training to nursing officer at immunization clinic. Vaccines wastage trend of DPT, JE, IPV, Penta in the starting is higher than gradually decreases in 2022, 2023 due to community mobilization to immunization centre by department of community medicine, awareness about vaccine preventable diseases, proper training to nursing officers, maintaining storage and cold chain system, quality of infrastructure like ILR, deep fridge etc., and vaccine procurement. Regarding PCV vaccine, very minimal wastage due to PCV vaccination stopped after COVID and most of the people are not willing. Very high wastage occurs at clinic, when health care workers open a multi-dose vaccine vial which cannot be used in subsequently which leads to open vial wastage but vaccine open vial policy strategies is opening vials even for single dose to avoid missed opportunities[10].

Conclusions

The current study shows wastage rate for BCG is the highest (80.45%) followed by MR (68.37%), IPV (67.63%), DPT (64.44%) which is beyond the national limits. To avoid vaccine wastage, need to do regular monitoring, proper logistics management, training to health care professionals, community mobilization for vaccination and well establishment of department of paediatrics and OBG. Assessment of vaccine wastage, trend are essential to ensure that a maximum number of procured doses reach beneficiaries with minimal wastage at all levels.

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Conflict of interest

To know the accessibility and utility of vaccines to beneficiaries as for national immunization schedule(NIS) at newly established tertiary care centre.

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