



Assessment of Vaccine Wastage in Tertiary Care Centre of District Nagpur, Maharashtra

KEYWORDS

vaccine wastage, Immunization, cold chain

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ABSTRACT *Background: Development of vaccine was one of the greatest discoveries as it saved thousands of lives over the period. India has one of the largest Immunization program in the world. Routine immunization is one of the most cost effective interventions. Vaccine wastage is also an expected component of immunization program. This study primarily focuses on the estimation of wastage rate and wastage factor for vaccines used in Immunization clinic. Material and Methods: A record based descriptive study carried out at Immunoprophylaxis clinic functions under Community Medicine Department of Govt. Medical College, Nagpur. The data was collected for one year from 01 December 2014 to 30 November 2015 and analysed to find out vaccine wastage, vaccine wastage rate and wastage factor. Results: The vaccine wastage was found highest for BCG (22.93%) followed by Measles (11%). Lowest wastage was seen in use of DPT vaccine (3.49%). The wastage rate and wastage factor for 5 dose vials was higher than 10 and 20 doses vial and higher for Lyophilized vaccine than Liquid vaccine used in these settings. Conclusion: Some level of vaccine wastage is unavoidable. The country like India where maximum immunization carried out by outreach immunization sessions, the wastage is inevitable to control. Wastage of vaccine because of break in cold chain, frozen vaccine, loss or breakage during transportation and wastage because of the expiry of vaccine batches can be avoidable with careful handling and monitoring.*

INTRODUCTION

Vaccines are one of the greatest achievements of biomedical science and public health and represent one of the most effective tools for the prevention of diseases. ¹ Lots of lives were saved because of the discovery and widespread use of the vaccines. Discovery of vaccine help us to control, eliminate and even for eradication of infectious diseases from countries and world causing reduction in mortality, morbidity and disability. India has one of the largest Universal Immunization Programs in the world. The program budgets more than US\$ 500 million every year for immunizing children against vaccine preventable diseases. ²

Routine Immunization is one of the most cost effective public health interventions and was first introduced in India in 1978. Yet, despite the concerted efforts of the Government and other health agencies, a large proportion of vulnerable infants and children in India remain unimmunized. India has the highest number (approximately 10 million) of such children in the world. ³ Regular supply, efficient management and monitoring, tracking of unimmunized child, ensuring complete immunization and expanding the immunization coverage in low performance areas are very important for the success of immunization programme. In immunization program, the number of vaccine doses used is always higher than the number of beneficiaries actually immunized. This excess number of doses which remain unutilized contributes to wastage of vaccines at the service delivery level. Wastage is often defined as "loss by use, decay, erosion or leakage or through wastefulness". ⁴

Vaccine wastage may result from a variety of causes, such as (a) expiration before usage can occur; (b) heat (or freezing) damage due to breaks in the "cold chain" when vac-

cine is left out of refrigeration or cooling/insulating equipment fails; (c) physical damage due to crushing, dropping, or loss of label; (d) losses in transit or inventory; and (e) incomplete use of the nominal number of doses in multidose vials. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) have estimated overall wastage rates in developing countries of around 50%. ⁵

Vaccine wastage is an expected component of any immunization program. In order to ensure that no child is missed during an immunization session, the vaccine is procured with estimated wastage. Effective vaccine utilization is an integral component of vaccine security, and vaccine wastage is one of the key factors to be considered with regards to vaccine forecasting and need estimation. However, systematic reviews for assessing vaccine wastage trends are still lacking hence the present study was undertaken with an objective to assess vaccine wastage.

MATERIAL AND METHOD:-

This record based descriptive study was carried out at Immunoprophylaxis clinic which functions under Community Medicine department, Government Medical College and Hospital, Nagpur. The national immunization schedule was followed in which six vaccines, i.e. BCG, DPT, OPV, Hepatitis B, Measles and TT were given to prevent and protect the children from respective diseases.

The vaccines that provided for immunization are multidose vials i.e. BCG, DPT, Hepatitis B and TT are 10 dose vial vaccine whereas Measles is 5 dose vial vaccine and Polio, 20 dose vial vaccine. Measles and BCG are provided as lyophilized form i.e. they need to prepare before vac-

cination while all the other vaccines are provided in liquid form and can be readily used. According to the multidose vaccine vial policy, the lyophilized vaccine should be used within 4 hours after opening of vial and reconstitution, but the liquid vaccines are allowed to reuse which has been taken out for immunization atleast three times or has been kept in cold storage for 28 days after opening of vial are discarded in order to safeguard the potency of vaccine.

In Immunoprophylaxis clinic (IPC), immunization by DPT, OPV, Hepatitis B, Measles and TT are done on daily basis and BCG is given on Monday and Thursday to all the children upto 16 years age group. The data is recorded daily in immunization register and monthly report is prepared which was used to collect the data on total children immunized and monthly wastage.

The data was collected for one year from 01 December 2014 to 30 November 2015 and analysed to find out vaccine wastage, vaccine wastage rate and wastage factor. The vaccine wastage rate was calculated by formula [(No. of doses wasted/No of doses used) x100] and wastage factor by [100/ (100-vaccine wastage rate)].⁴ The master sheet was prepared from all the information collected in Microsoft MS Excel, data was analysed and statistical tests were applied using Epi Info 7. P value was calculated for 95% confidence level.

RESULTS:-

TABLE I: - Wastage rate and wastage factor for different vaccines.

Vaccine	No. of doses issued	No. of children Vaccinated	No. of doses wasted	Vaccine wastage rate (%)	Vaccine wastage factor
BCG	1570	1210	360	22.93	1.30
OPV	10510	9806	704	06.70	1.07
DPT	8890	8580	310	03.49	1.04
Hepatitis B	6300	5919	381	06.50	1.07
Measles	4145	3689	456	11.00	1.12
T.T.	1630	1530	100	06.13	1.07

Total of 33045 vaccine doses were issued for the immunization against BCG, DPT, OPV, Hepatitis B, Measles and TT vaccination at Immunoprophylaxis clinic (IPC). The vaccine wastage rate and vaccine wastage factor was calculated and found highest for BCG i.e. 22.93% and 1.30 respectively followed by Measles which was 11% and 1.12 respectively. Lowest wastage was seen in use of DPT vaccine (3.49%).

TABLE II: - Wastage across types/forms of Vaccine.

Type/Form	No. of doses issued	No. of children vaccinated	No. of doses wasted	Vaccine wastage rate (%)	Vaccine wastage factor
Vial Size					
5 dose vial	4145	3689	456	11.00	1.12
10 dose vial	18390	17239	1151	06.26	1.07
20 dose vial	10510	9806	704	06.70	1.07
Type of Vaccine					
Lyophilized	5715	4899	816	14.28	1.17
Liquid	27330	25835	1495	05.47	1.06
Mode of Administration					

Lyophilized	5715	4899	816	14.28	1.17
Liquid	27330	25835	1495	05.47	1.06

Vaccine vial size: -

The vaccine used were categorized in three different sizes of vial i.e. 5 dose (Measles), 10 dose (BCG, DPT, Hepatitis B and TT) and 20 dose (OPV) per vial. The wastage rate and wastage factor for 5 dose vials was higher than 10 and 20 doses vial. Difference in wastage rate for 5 doses versus 10 doses vial size was statistical significant ($\chi^2= 4.31$, $p = 0.04$) but for 10 doses versus 20 doses ($\chi^2= 0.07$, $p = 0.79$) and for 5 doses versus 20 doses ($\chi^2= 3.14$, $p = 0.08$) was not found significant.

Type of Vaccine:-

The vaccine supplied under National Immunization program comes in Liquid and Lyophilized form. DPT, OPV, Hepatitis B and TT are Liquid vaccine whereas BCG and Measles came as Lyophilized or freeze dried vaccine. The wastage rate and wastage factor was found higher for Lyophilized vaccine than Liquid vaccine used in these settings. There is statistically highly significant difference in wastage between Liquid and Lyophilized vaccine ($\chi^2= 21.06$, $p = 0.000$).

Mode of Administration: -

OPV is administered by oral route and all the other vaccine has injectable mode of administration. The vaccine wastage rate and wastage factor was found higher in injectable vaccine than oral route administrated vaccine. There is no statistically significant difference between these two modes of administration ($\chi^2= 0.07$, $p = 0.78$).

DISCUSSION:-

The vaccine wastage is important, if reduced can spare the Government money which can be used for introduction of newer and expensive vaccines which can be used to control other vaccine preventable diseases.

The Ministry of Health and Family Welfare, Government of India has recommended that vaccine wastage rate of 25% or wastage factor 1.33 is allowed for all vaccines used in immunization program.³ The World Health Organization has also projected vaccine wastage rate in order to help in calculating vaccine needs. According to the WHO, projected vaccine wastage rate for lyophilized vaccines is expected to be 50% wastage rate for 10-20 dose vials, and for liquid vaccines 25% wastage rate for 10-20 dose vials.

According to the results of this study, the vaccine wastage rate and wastage factor are found much lower than the limits of the Ministry of Health and Family Welfare, Government of India and WHO. This may because of the Hospital is tertiary care centre and daily vaccination sessions may results in low vaccine wastage in the centre.

The wastage rate and wastage factor in our study, for 5 dose vials (Measles) was higher than 10 and 20 doses vial. The findings of other studies were also consistent with the present study.^{4, 6, 7} The wastage rate and wastage factor for 5 dose, 10 dose and 20 dose vials were 11%, 6.26%, 6.70% and 1.12, 1.07, 1.07 respectively. These values were much lower than the studies by Gupta V et al,⁴ Mehta S et al,⁶ and Chinnakali P et al.⁸ The study conducted by Praveena Daya A et al⁷ found high value of vaccine wastage rate and factor i.e. 46.5% and 1.86 respectively for 5 dose vial which was higher than our study values but the VWR and VWF for 10 dose and 20 dose vial (VWR 5.3%,

1% and VWF 1.05, 1.01) was much lower than present study results. The UNICEF found negligible difference in wastage between 5 doses and 10 doses vaccine (approx. 35%) whereas 20 dose vaccine wastage was 47%.²

In present study, the vaccine wastage rate and wastage factor for lyophilized vaccine (14.28% and 1.17 respectively) was found higher than Liquid vaccine (5.47% and 1.06 respectively) used for vaccination. Similar results that vaccine wastage more for Lyophilized vaccine were found by UNICEF (Lyophilized 50%, Liquid 38%),² Gupta V et al (Lyophilized 63.76%, Liquid 26.36%),⁴ Mehta S et al (Lyophilized 37.8%, Liquid 20.16%),⁶ and Praveena Daya A et al (Lyophilized 28.2%, Liquid 3.4%)⁷ but the Chinnakali P et al⁸ found negligible difference in wastage for both Lyophilized and Liquid vaccine (Lyophilized 48.4%, Liquid 48.2%).

The wastage rate for injectable vaccine (7.13%) was found more than the oral vaccine (6.70%). Similar results that injectable vaccine had more wastage than oral vaccine was found by Gupta V et al (Injectable 40.34%, Oral 28.97%),⁴ and Praveena Daya A et al (Injectable 10.9%, Oral 1.03%),⁷ but Mehta S et al⁶ in their results found more wastage for Oral vaccine than the Injectable vaccine (Injectable 22%, Oral 25%). Similarly UNICEF² also had more wastage for oral vaccine (47%) than injectable (35%). A study conducted by Chinnakali P et al⁸ found negligible difference in wastage between Injectable and oral vaccine (Injectable 48.3%, Oral 48.1%).

The vaccine wastage rate (VWR) of BCG vaccine was 22.93% and wastage factor (VWF) 1.30 which was highest in this study followed by Measles (VWR 11% and VWF 1.12). Still they were below the recommended values by Ministry of Health and Family Welfare, Government of India and WHO. VWR and VWF were highest for BCG found in various studies done in India.^{2,4,6,8,9} The vaccine wastage for BCG was 22.93% which is much lower than the results found by UNICEF (61%),² Gupta V et al (77.9%),⁴ Mehta S et al (45%)⁶ and Chinnakali P et al (70.9%).⁸ This may be because the vaccine as per national guidelines should be discarded after four hours of reconstitution. So if the adequate childrens if not approached to the site, many doses have to be discarded resulted into higher vaccine wastage of this vaccine.

The wastage rate for OPV was 6.70% which found much lower than UNICEF (47%)² and most of the other studies i.e. Gupta V et al (28.97%),⁴ Mehta S et al (25%),⁶ Chinnakali P et al (48.1%),⁸ Mentey V et al (51.2%),⁹ and Mukherjee A et al (14.5%)¹⁰ but results found by Praveena Daya A et al (2.4%)⁷ was much lower than our study.

The wastage rate calculated for DPT was 3.49% which was found lower than results calculated by UNICEF (27%),² Gupta V et al (46.75%),⁴ Mehta S et al (16%),⁶ Praveena Daya A et al (8.4%),⁷ Chinnakali P et al (38.6%),⁸ and Mentey V et al (29.4%).⁹

The calculated wastage rate for Measles vaccine was 11% which also lower than the wastage rate obtained by UNICEF (35%),² Gupta V et al (41.28%),⁴ Mehta S et al (28%),⁶ Praveena Daya A et al (46.5%),⁷ Chinnakali P et al (39.9%),⁸ and Mentey V et al (51.1%).⁹

The vaccine wastage for Hepatitis B was 6.50%, much lower than the results obtained by UNICEF (33%),² Gupta V et al (38.66%),⁴ and Mehta S et al (21%)⁶ but Praveena Daya A et al⁷ found only 5.3% of wastage for Hepatitis B

vaccine quite similar to our study.

The wastage for TT vaccine was only 6.13% in present study, much low wastage than studies by UNICEF (34%),² Gupta V et al (36.81%)⁴ and Chinnakali P et al (62.8%)⁸ but Praveena Daya A et al⁷ found only 4.2% of wastage, lower than present study result.

CONCLUSION:-

Some level of vaccine wastage is unavoidable. The country like India where maximum immunization carried out by outreach immunization sessions, the wastage is inevitable to control. Also to increase the vaccination coverage, childrens should be immunized irrespective of the wastage occurred causing wastage of rest of doses.

The wastage of vaccines is somewhat unavoidable because opened vial generally discarded after the immunization session specially lyophilized vaccine which cannot be used after 4 hours. But the wastage of vaccine because of break in cold chain, frozen vaccine, loss or breakage during transportation and wastage because of the expiry of vaccine batches can be avoidable with careful handling and monitoring. Reduction of vaccine wastage can prevent the government financial resources which can be used to introduce the new vaccines in Immunization Programme.

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