

**Original article****EVALUATION OF VACCINE WASTAGE IN SURAT****Shreyash Mehta<sup>1</sup>, Pradeep Umrigar<sup>1</sup>, Prakash Patel<sup>2</sup>, R K Bansal<sup>3</sup>****Financial Support:** None declared**Conflict of interest:** None declared**Copy right:** The Journal retains the copyrights of this article. However, reproduction of this article in the part or total in any form is permissible with due acknowledgement of the source.**How to cite this article:**

Mehta S, Umrigar P, Patel PB, Bansal RK. Evaluation of Vaccine Wastage in Surat. Natl J Community Med 2013; 4(1): 15-9.

**Author's Affiliation:**<sup>1</sup>Resident, <sup>2</sup>Assistant Professor, <sup>3</sup>Professor & Head, Department of Community Medicine, SMIMER, Surat**Correspondence:**Dr. Shreyash Mehta,  
Email: shreyash111@gmail.com**Date of Submission:** 19-01-12**Date of Acceptance:** 27-03-13**Date of Publication:** 31-03-13**ABSTRACT****Introduction:** Vaccine wastage is one of the key factors to be considered with regards to vaccine forecasting and need estimation.**Objective:** This study was conducted to assess the amount of vaccine wastage; its correlation with type of vaccine and place of vaccination; with route of administration and wastage and with beneficiaries per session and wastage factor (WF).**Methods and Materials:** Session wise data on vaccine usage and its beneficiaries were collected from 36 Urban health centre (UHC) of Surat Municipal Corporation (SMC). Vaccine wastage rate, vaccine wastage factor were calculated for each type of vaccine and each site of session and correlation analysis was done between the variables beneficiaries per session and wastage factor per session.**Results:** The overall wastage factor for BCG vaccine was 1.83, for OPV was 1.33, for DPT was 1.19, for Hepatitis B vaccine was 1.26 and for Measles vaccine was 1.39. The WF was highest for sessions held at ICDS for BCG vaccination (3.38) followed by sessions held at mobile sites for BCG vaccination (2.50). The WF was lowest for sessions held at UHC for DPT vaccination (1.11) followed by sessions held at subcentres for DPT vaccination (1.13) and sessions held at UHC for Hepatitis vaccination (1.13).**Conclusions:** BCG vaccine and Measles vaccine had WF greater than the allowable WF 1.33, OPV had WF of 1.33, DPT vaccine and Hepatitis vaccine had WF less than 1.33. WF was less for fixed sites of vaccination like the UHCs and subcentres while the WF was more ICDS and mobile sites.**Keywords:** Vaccine wastage, Vaccine wastage rate, Wastage factor, UHC, ICDS, SMC**INTRODUCTION**

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, including the polio eradication program<sup>1</sup>. Wastage is defined as loss by use, decay, erosion or leakage or through wastefulness. The World Health Organization reports over 50% vaccine wastage around the

world<sup>2</sup>. Many tools are available for reducing vaccine wastage but high rates of wastage are still prevalent across the globe. Vaccine wastage can be classified as occurring "in unopened vials" and "in opened vials". Expiry, VVM indication, heat exposure, freezing, breakage, missing inventory and theft are the forms of vaccine wastage affecting unopened vials. Vaccine wastage in opened vials may also occur because doses remaining in an opened vial at the end of a session are discarded, the number of

doses drawn from a vial is not the same as that indicated on the label, reconstitution practices are poor, opened vials are submerged in water, and contamination is suspected.

Vaccine wastage is an important factor in forecasting vaccine needs. In the absence of local or national data on wastage rates, if incorrect figures are used, the country concerned may face serious vaccine shortages or be unable to consume received quantities, leading to increased wastage through expiry. Such monitoring can provide programme managers with good guidance on the introduction of corrective actions to reduce wastage whenever necessary. With the introduction of new vaccine management policies such as the application of multidose vial policy (MDVP), the effective use of vaccine vial monitors (VVMs), and improved immunization strategies and practices, vaccine wastage is expected to decrease. There is lack of comprehensive study done in India to validate the wastage rate recommended by WHO and Ministry of Health and Family Welfare. Very few published studies in India have studied the wastage rate of vaccines<sup>1,3,4,5,6</sup>. This article attempts to calculate the vaccine wastage rates in an urban setting in Surat Municipal Corporation.

## MATERIALS AND METHODS

This was a record based descriptive study to be carried out in 36 urban health centres of Surat Municipal Corporation. There is a dedicated team of field workers consisting of four Multipurpose Health workers (2 male and 2 female) and one Public Health Nurse (PHN) who conduct immunization sessions at a fixed site on fixed days. National Immunization Schedule recommended by Ministry of health and family welfare was followed<sup>7</sup>. BCG, DPT and HBV vaccines vials used were 10 dose preparations, Measles vials were 5 dose preparations and OPV vials were 20 dose preparations.

**Study population & Study period:** All children who got vaccinated between 1st January 2012 and 31st March 2012 were included in the study.

**Data retrieval and analysis:** The information of vaccine vials used during immunization sessions and children vaccinated were retrieved from the immunization registers for the period of 1st January 2012 and 31st March 2012 maintained by the public health nurse. The no. of doses wasted was calculated using the formula (No. of doses issued- no. of children benefitted) Vaccine

wastage rate was calculated using formula [(No. of doses wasted/ No. of doses issued) X 100] Vaccine Wastage Factor was calculated by using the formula [100/ (100-vaccine wastage rate)]<sup>8</sup>. Data were entered into Microsoft Excel spread sheet and descriptive analysis was done.

## RESULTS

Due to other important ongoing national programmes, Intensive Pulse Polio Immunization (IPPI), incomplete data entry and feasibility issues data from 24 UHC out of 36 UHC could only be taken for analysis of vaccine wastage. A total of 2399 immunization sessions were conducted during the study period. A total of 5 vaccines (BCG, OPV, DPT, HBV and Measles) had been given to children. The information regarding the no. of vaccine vials and doses used for vaccination, children vaccinated, the wastage rate and wastage factor (WF) for each vaccine are provided in table 1.

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

Vaccine	Doses consumed	Children vaccinated	Wastage rate	WF
BCG*	16532	9032	45%	1.83
OPV@	42290	31732	25%	1.33
DPT*	52180	43854	16%	1.19
HBV*	39069	31029	21%	1.26
Measles#	12941	9312	28%	1.39

# 5 dose vial vaccine; \*10 dose vial vaccine; @20 dose vial vaccine

Among individual vaccines, wastage factor is highest for BCG and lowest for DPT (Table-1).

**Vial size:** The vaccines are supplied in 3 different sizes of vials; 5 doses (Measles), 10 (BCG, DPT, HBV) and 20 (OPV) per vial.

For vaccines of 5 dose preparations (Measles), the wastage rate was 28% and wastage factor was 1.39. For vaccines of 10 dose preparations (BCG, DPT, HBV) the wastage rate was 22% and wastage factor was 1.28. For vaccines of 20 dose preparations (OPV), the wastage rate was 25% and wastage factor was 1.33.

**Liquid and Lyophilized vaccine:** The vaccine vials come in liquid and lyophilized forms. Three vaccines namely OPV, DPT and HBV are supplied in liquid form and 2 vaccines; BCG and Measles are freeze dried or lyophilized vaccines. Among these, wastage factor and wastage rate

were higher in lyophilized vaccines (1.61) and (37.8%) compared to that of liquid vaccines i.e. (1.25) and (20.16%).

**Mode of Administration:** All the vaccines except for OPV are administered through injection. The wastage factor and wastage rate for injectable vaccines (BCG, DPT, HBV and Measles) were found to be 1.29 and 22% and for oral (OPV)

were found to be 1.33 and 25% respectively. Thus, there is negligible difference in wastage between the two modes of administration.

A correlation between the number of beneficiaries per session and WF per session was calculated. The value of correlation coefficient ( $r$ ) and P-value was calculated.

**Table 2: Correlation of vaccine beneficiary and wastage factor (WF)**

variables	Correlation Coefficient ( $r$ )	P- value
BCG beneficiary per session and its WF per session	-0.046	0.019
OPV beneficiary per session and its WF per session	0.048	0.015
DPT beneficiary per session and its WF per session	-0.029	0.145
HBV beneficiary per session and its WF per session	-0.068	0.01
Measles beneficiary per session and WF per session	0.035	0.170

## DISCUSSION

The Ministry of Health and Family Welfare, Government of India has recommended that wastage rate of all vaccines should not be higher than 25% (Wastage factor of 1.33)<sup>9</sup>. The World Health Organization has also projected vaccine wastage rate in order to help in calculating vaccine needs<sup>8</sup> 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<sup>8</sup>. The present study showed that the vaccine wastage for OPV was higher than the limits given by the Ministry of Health and Family Welfare, Government of India<sup>9</sup>, as well as by WHO<sup>8</sup>. The wastage rate of BCG, Measles exceeded the recommendation limit set by the national government, were above the recommended wastage rate by the WHO. A field based assessment and observation done by National Rural Health Mission (NRHM) and UNICEF<sup>1</sup> documented the vaccine wastage rate for vaccines under Universal Immunization Programme (UIP) at session sites to be 61% for BCG, 47% for OPV, 27% for DPT, 33% for HBV and 35% for Measles vaccine which more than the wastage rate obtained from our study.

The wastage rate for 5 dose vaccine vial (Measles) was 28% , for 10 dose vaccine vial (BCG, DPT, HBV) was 22% and for 20 dose vaccine vial (OPV) was 25% which are lower than the wastage rate obtained by Palanivel C. et al<sup>3</sup> and a field based assessment and observation done by National Rural Health Mission (NRHM) and UNICEF<sup>1</sup>. However, the wastage rate

deduced is more than the vaccine wastage rate recommended by WHO.

The wastage rate were higher in lyophilized vaccines (37.8%) compared to that of liquid vaccines (20.16%). This is similar to the findings from other studies<sup>6,7</sup>. This may be due to the fact that the lyophilized vaccines need to be discarded within 4 hours after reconstitution<sup>9</sup>.

The wastage rate for injectable vaccines (BCG, DPT, HBV and Measles) were found to be 22% and for oral (OPV) were found to be 25%. Thus there is negligible difference in vaccine wastage between oral and injectable route of administration of vaccines. This is similar to the findings by Palanivel C et al<sup>3</sup> but differs from the findings by a field based assessment and observation done by National Rural Health Mission (NRHM) and UNICEF<sup>1</sup>.

The value of correlation coefficient ( $r$ ) calculated for the correlation between variables BCG beneficiary/session and WF for BCG/session was -0.046 and P-value calculated was 0.019 i.e. less than 0.05 which means that both variables are negatively correlated. This can be interpreted as for 95% of cases, as the no. beneficiaries per session decrease the WF per session increase. This may be due to the fact that BCG being a lyophilized vaccine is to be discarded within 4 hours of constitution<sup>9</sup> and no. of beneficiaries per session is less. The wastage rate for BCG obtained for other studies<sup>1,3,10</sup> was found to be much higher than our study.

The value of correlation coefficient ( $r$ ) calculated for the correlation between variables OPV beneficiary per session and WF for OPV per

session was 0.048 and P-value calculated was 0.015 i.e. less than 0.05 which means that both variables are positively correlated. This can be interpreted as for 95% of cases, as the no. beneficiaries per session increase the WF per session increase. This may be due to the fact that there might be wastage of OPV at time of administering of vaccine e.g. administering more drops than that are required to be given per dose due to faulty vaccinating technique of vaccinators, child moving the head at the time of ingestion of vaccine etc. The wastage rate for OPV obtained from some studies<sup>1,3</sup> were higher than that obtained from our study. But in a study by Mukherjee et al<sup>4</sup> to assess wastage factor of oral polio vaccine (OPV) in the Pulse Polio Immunization (PPI) programme of the Government of India at approximately 31,000 immunization booths all over the country estimated that wastage at the point of administration of OPV was 14.5% with a wastage factor of 1.17. Though the wastage rates are less compared with the present study, this study cannot be compared with the present study as Pulse Polio program involves mass mobilization and it is not a routine immunization program. Studies by Jain et al<sup>5</sup> and Samant et al<sup>6</sup> were assessing the wastage due to cold chain failure and didn't attempt to estimate the wastage rates of OPV.

The wastage rate calculated for DPT was 16% which is less than the wastage rate calculated by other studies<sup>1,3,10</sup>. This may be due to fact that more number of DPT doses (3 or 4 doses of DPT for single child versus single dose of BCG) required and hence number of eligible children available per vaccination session will be more.

The value of correlation coefficient (r) calculated for the correlation between variables HBV beneficiaries per session and WF for HBV per session was -0.068 and P-value calculated was 0.01 i.e. less than 0.05 which means that both variables are negatively correlated. This can be interpreted as for 99% of cases, as the no. beneficiaries per session decrease the WF per session increase. The wastage rate at session sites obtained by NRHM and UNICEF report<sup>1</sup> was 33% which is higher than that calculated from our study i.e. 21%.

The wastage rate calculated for Measles vaccine was 28% which is lower than the wastage rate obtained by other studies<sup>1,3,10</sup> but higher than the recommended wastage rate by the Ministry of Health and Family Welfare, Government of

India<sup>9</sup>, as well as by WHO<sup>8</sup>. This may be due to the fact that measles is a lyophilized vaccine and is to be discarded within 4 hours of constitution<sup>8</sup> and no. of beneficiaries per session is less.

Deficiencies in vaccine management and high wastage increase vaccine demand and inflate overall program cost. Lower demand for vaccine favors the way for fewer dose preparations. The cost of fewer dose preparations is higher as vaccine filling in vials is expensive, but cost to the programme may be less even if some vaccine remaining in multi-dose vials must be thrown away. Vaccine wastage can be expected in all programmes and there should be acceptable limit of wastage. This might differ from location to location depending on many factors like urban or rural setting, immunization coverage etc. The questions arise as to whether the wastage is preventable and, if so, how to prevent it. It is also important to know the type of vaccine wastage. A high wastage rate attributable to opening a multidose vial for a small session size in order to avoid missed opportunities is more acceptable than wastage attributable to freezing or expiry. Higher wastage rates are acceptable to increase vaccine coverage in a low vaccine coverage setting<sup>11</sup>.

## CONCLUSION

Vaccine wastage rates are higher than expected in urban setting at the delivery level. Further details of the vaccine wastage can be obtained by actual monitoring of the vaccination session. Monitoring vaccine wastage is useful as a programme monitoring tool to improve programme quality and increase the efficiency of the programme.

## RECOMMENDATIONS

Vaccine wastage calculations should be done routinely to assess the loss due to wastage. This can save significant funds for an immunization programme if wastage can be reduced without affecting the coverage. In rural areas of India there are grass root level health workers for every 1000 population, (known as Accredited Social Health Activists and Anganwadi workers) who help in identifying the unimmunized and mobilizing the eligible children but in urban areas there is a shortage of grass root level workers. Mobilizing the eligible children with the help of community mobilizers and

organizing the immunization sessions in collaboration with government, private clinics in the locality will help to reduce the wastage.

## REFERENCE

1. Vaccine Wastage Assessment, April 2010. Field assessment and observations from National stores and five selected states of India. UNICEF. Available at [http://www.unicef.org/india/Vaccine\\_Wastage\\_Assessment\\_India.pdf](http://www.unicef.org/india/Vaccine_Wastage_Assessment_India.pdf). Accessed on 10th March 2013
2. Monitoring vaccine wastage at country level. Guidelines for programme managers. Vaccines and Biologicals. World Health Organization. Available at [www.who.int/vaccines-documents/](http://www.who.int/vaccines-documents/). Accessed on 10th March 2013.
3. Palanivel C, Kulkarni V, Kalaiselvi S, Baridalyne N. Vaccine wastage assessment in a primary care setting in urban India. *Journal of Pediatric Sciences*. 2012;4(1):e119
4. Mukherjee A, Ahluwalia TP, Gaur LN, Mittal R, Kambo I, Saxena NC, Singh P. Assessment of Vaccine Wastage during a Pulse Polio Immunization Programme in India. *J Health Popul Nutr* 2004 Mar; 22(1):13-18.
5. Jain R, Sahu AK, Tewari S, Malik N, Singh S, Khare S, Bhatia R. Cold chain monitoring of OPV at transit levels in India: correlation of VVM and potency status. *Biologicals*. 2003 Dec; 31(4):237-44.
6. Samant Y, Lanjewar H, Parker D, Block L, Tomar GS, et al. Evaluation of the cold-chain for oral polio vaccine in a rural district of India. *Public Health Rep*. 2007;122:112-121.
7. National Immunization Schedule for Infants, Children and Pregnant Women. Revised IPHS guidelines (2010). Directorate General of Health Services. Ministry of Health & Family Welfare. Government of India.
8. Immunization service delivery and accelerated disease control, World Health Organization. Available at [http://www.who.int/immunization\\_delivery/vaccine\\_managementlogistics/logistics/expected\\_wastage/en/index.html](http://www.who.int/immunization_delivery/vaccine_managementlogistics/logistics/expected_wastage/en/index.html). Accessed on 10th March 2013
9. Immunization Handbook for Medical Officers. Department of Health and Family Welfare, Ministry of Health and Family Welfare, Government of India 2008. Page 31-32.
10. Guichard S, Hymbaugh K, Burkholder B, Diorditsa S, Navarro C, Ahmed S, Rahman MM. Vaccine wastage in Bangladesh. *Vaccine*. 2010 Jan 8; 28(3):858-63. Epub 2009 Aug 27.
11. Richard Duncan, Global Alliance for Vaccines and Immunization support to introduce hepatitis B vaccine, Lao People's Democratic Republic, 26 February to 11 May 2002, MR/2002/0066, WHO WPRO.