Original Article

Evaluation of Temperature Monitoring System of Cold Chain at all Urban Health Centres (UHCs) of Ahmedabad Municipal Corporation (AMC) area.

Kapil J. Govani[1], Jay K. Sheth[2]

[1] Assistant Professor, Dept. of Community Medicine, GMERS Medical College, Valsad, Gujarat, India. [2] Assistant Professor, Dept. of Community Medicine, Smt. NHL Municipal Medical College, Ahmedabad, Gujarat, India.
Corresponding Author : Kapil J. Govani, E mail: kapilgovani@gmail.com

Abstract :

Introduction : Temperature monitoring system is an important element of cold chain. **Objectives :** 1) To evaluate the temperature monitoring system of cold chain at UHC level.2) To take necessary corrective measures whenever required and give relevant advices to handlers for improving the system. **Method :** A cross sectional study was conducted at all the 56 UHCs of AMC area during May 2012 to January 2013. Pretested check list was used having details of various cold chain elements. **Results & Discussion :** Significant difference was found regarding the placement of alcohol & dial thermometer in ILR & DF respectively (P: 0.028). Documentation of temperature in temperature logbook twice daily on regular basis was satisfactory. Poor documentation was noted for power failure (12.5%) and for defrosting status (41%) in record book. ILR (Ice Lined Refrigerator) breakdown was noted significantly in temperature logbook (P: 0.004). **Conclusion :** Temperature logbook was regularly updated still there was scope for improvement regarding documentation of power failure and defrosting status.

Key words : Temperature record,cold chain, UHC

Introduction :

Cold chain is a system of storing and transporting vaccine at the recommended temperature range from the point of manufacture to point of use. [1-3]Cold Chain and vaccine management are the left and right hands of immunization programme. [4] Temperature monitoring system was very important component to avoid cold chain failure. Deep Freeze (DF) and Ice Lined Refrigerator (ILR) are to electrical equipment available at UHC level. A break in the cold chain is indicated if temperature rises above $+8^\circ$C or falls below $+2^\circ$C in the ILR; and above -15°C in the Deep Freezer. [5, 6] The ILR and Deep freezers each should have separate thermometer and temperature record book and temperature must be recorded twice daily (morning and evening). [3,7]After recording the temperature, cold chain handlers should sign on the temperature record book. Every week Medical Officer (MO) in-charge should record the temperature and sign on the record book. [8]such records should be checked during supervisory visits. The thermometer should be kept in between the freeze sensitive vaccine inside the basket of the ILR. [2,9]There are mainly three types of thermometer.[1]

Dial thermometer: It has dial with moving needle to show the temperature of vaccine within the range of -50°C to $+50^\circ$C.(2) Alcohol Stem thermometer: It is much sensitive and accurate than dial thermometers.[5, 10] They can record temperatures from -50°C to $+50^\circ$C and can be used for ILRs and deep freezers. As it is very sensitive, it should not be taken out from the ILR and reading must be noted immediately.(3) Electronic / Digital thermometer: It is also known as control panel.

Every vaccination is not immunization so potency of all vaccines needs to be well maintained. One of important component of cold chain is maintaining each vaccine in recommended temperature for vaccine potency. Dealing with larger number of vaccine stocks in major cities, is also increases the chance of cold chain failure. The Ahmedabad Municipal Corporation (AMC) is an urban area with many challenges, as far as maintenance of cold chain is concerned. Thus, looking in details of cold chain system in an urban area is very much required. So study was conducted at all UHCs of AMC with following objectives.

Objectives :

1) To evaluate the temperature monitoring system of cold chain at UHC level.

2) To take necessary corrective measures whenever required and give relevant advices to handlers for improving the system.

Method :

Ahmedabad Corporation is divided in 6 zones and has total 57 wards with a city population of 5,570,585.[11] Zone wise distribution of fifty seven UHCs shows that West Zone (WZ), New west Zone (Nwz), East Zone (Ez) and North Zone (Nz) have 10 UHCs each. While Central Zone (Cz) is having 09 UHCs and South Zone (Sz) is having 08 UHCs.The present cross sectional study was conducted at all 56 UHCs of AMC area during May 2012 to January 2013.As far as the cold chain system of UHC is concern, there are fifty six UHCs, because two UHCs of East zones (Rajpur and Rakhiyal) are working as a single unit for immunization coverage and there is single set of all cold chain equipments for both UHCs. In AMC area responsibility of cold chain and vaccine management at all UHCs is under Registrar of Birth & Death department (RBD department). Due permission was taken from RBD department, Health sector, AMC. Institutional Review Board (IRB) of Smt. N.H.L. Municipal Medical College, Ahmedabad approved the study and gave ethical clearance. Fully structured checklist, which was specially designed and pre-tested, was used for data collection purpose at all UHCs. The check list contains details of various components of cold chain. Among them one of the important components is temperature monitoring system. Which contents (1) Evaluation of temperature logbook records (2) Availability, placement and functional status different types of thermometer. At each UHC this check list was filled and corrective measures were taken wherever necessary. Data entry was carried out and data analysis was done by using appropriate statistical software and applying suitable statistical tests.

Results :

Among all UHCs, 54 DFs and 53 ILRs were found in working condition. digital (electronic) thermometer was present in many of electrical equipments but was not in working condition, in all of them. Majority of DF & ILR had internal thermometer. Significant findings were noted regarding availability of alcohol thermometer in ILR and dial thermometer in DF (Table-1). As compare to digital (electronic) thermometer, temperature of internal thermometer was noted in temperature record book at majority of UHCs. Complete temperature record of last 1 year was available only at 21 (37.5%) of the UHCs. There were significant breakdowns in ILR as compare to DF. At 4 UHCs a total of 6 DF breakdowns were reported (At 1 UHC 3times DF breakdown in 1 year). For ILR, a total of 20 breakdowns were reported at 17 UHCs (With 2 & 3 breakdown at one UHC each) (Table-1).

Table 1 : Status of temperature monitoring system of Electrical equipments at UHC level.

Sr. No.	Points to be observed Internally for DF (N=54) and ILR (N=53) Equipment	DF (N=54)		ILR (N=53)		Chi-square value	P value
		Yes	No	Yes	No		
1.a	Digital Thermometer (Electronic) present	46	08	41	12	1.08	0.30
1.b	Digital Display in Working condition	29	17	27	14	0.075	0.78
1.c	Digital Display in visible condition	29	17	27	14	0.075	0.78
2.a	Separate internal thermometer present	49	05	51	02	0.57	0.45
2.b	Alcohol thermometer present	21	28	33	18	4.80	0.028
2.c	Dial thermometer present	28	21	18	33	4.80	0.028
2.d	Functional thermometer properly placed	46	03	44	07	0.87	0.35
3.a	Alcohol thermometer temp. in record book	18	36	31	22	6.82	0.009
3.b	Dial thermometer temp. in record book	28	26	16	37	5.18	0.023
3.c	Digital thermometer temp. in record book	08	46	06	47	0.29	0.59
3.d	Complete data records of temperature in temp. books of last 1 year	21	35	21	35	0.00	1.0
3.e	Equipments breakdown noted in temp. books at UHCs (last 1 year data)	04	52	17	39	8.44	0.004

All the UHC had temperature record book/logbook. Majority (83.9%) had placed it nearer to DF/ILR. Monitoring of temperature of electrical cold chain equipments on daily basis was satisfactory (92.9%) but poor documentation of power failure/cut (12.5%) and defrosting status (41.1%) was observed (Table-2). Cross check by MO of UHC was done on regular basis. As per health staffs, external supervision by AMC was satisfactory with a mean 3.1 supervisory visit per year. However documentation in temperature record book was not supporting this fact with an average 1.2 supervisory signature per year. Technical / mechanical services of DF/ILR were on call and not regularly basis. Not considering the routine inspection and maintenance visit by the technician, and only considering the 26 breakdowns, signature of technician was found at only 2 UHCs (Table-2).

Table 2 : Evaluation of Temperature record book at UHC level.

Sr. No.	Details of temperature record book (N=56 UHCs)	Yes (No.)	Percentage (%)
1	Temperature record book available	56	100.0
2	Temperature record book put nearer to DF / ILR	47	83.9
3	Temperature record book up to date till now	52	92.9
4	Documentation on power failure/cut done in temperature book (last 1 year data/record)	07	12.5
5	Documentation on defrosting status done in temperature book (last 3 months data/record)	23	41.1
6	Cross check by MO (see signature). (last month data)	50	89.3
7	Records of external checking by AMC available in temperature book (last 1 year data)	42	75
8	Signature of technician done in temperature book (last 1 year data/record)	02	3.6

Temperature detail of different types of thermometer and Temperature record data for ILR and DF according to their availability was mentioned in Table-3 & Table-4. Majority of internal thermometer findings shows normal temperature range for both DF & ILR (Table-5). Summary measures of temperature details of cold chain equipments were as per Table-6.

Table 3 : Comparison among temperature related data from different sources for Ice Lined Refrigerator (ILR) equipment.

Sr. No.	Temperature details for ILR	Seen on Digital thermometer of ILR (N=27)	Internal thermometer (Alcohol/Dial) Temperature (N=51)	In Temperature record book (N=49)
1	-2 .C	00	02	01
2	-1 .C	00	00	01
3	0 .C	01	01	00
4	1 .C	00	01	00
5	2 to 8 .C	26	47	47

Table 4 : Comparison among temperature related data from different sources for Deep Freeze (DF) equipment.

Sr. No.	Temperature details for DF	Seen on Digital thermometer of DF (N=29)	Internal thermometer (Alcohol/Dial) Temperature (N=49)	In Temperature record book (N=50)
1	-30 to -26 .C	00	00	01
2	-15 to -25 .C	23	43	47
3	-14 to -11 .C	02	04	02
4	-10 to -06 .C	04	01	00
5	-05 to 0 .C	00	01	00

Table 5 : Comparison of internal thermometer (Alcohol / Dial) temperature range between DF & ILR equipments.

Sr. No.	Internal thermometer Temperature details for DF and ILR	DF (N=49) (T= -15 to -25 °C)	ILR (N=51) (T= 02 to 08 °C)	Chi-square value	P value
1	Above Normal	06	00	4.65	0.03
2	Normal	43	47	0.16	0.69
3	Below Normal	00	04	2.22	0.14

Table 6 : Summary measures of temperature details of cold chain equipments.

Sr. No.	Details of cold chain equipment	Mean	SD	Min.	Max.	Median
1	**Details of DF**					
1.a	Display Temperature	-17.9	4.2	-25	-8.5	-17.8
1.b	Internal Thermometer Temperature	-18.1	4.5	-27	00	-19
1.c	Record book Temperature	-19.8	3.3	-28	-11	-20
2	**Details of ILR**					
2.a	Display Temperature	4.0	1.4	00	07	4.1
2.b	Internal Thermometer Temperature	3.9	1.9	-2	8	4
2.c	Record book Temperature	3.7	1.7	-2	8	4

Discussion :

As discussed, majority of DF & ILR had separate internal thermometers. As alcohol thermometer is more sensitive, it is preferred over dial thermometer for ILR. [3] The present study shows the significant findings regarding availability of alcohol thermometer in ILR and dial thermometer in DF (Table-1). The outer digital temperature indicator should not be recorded but was used at 8/54 & 6/53 UHCs for ILR & DF respectively. Temperature monitoring system is one of the important systems of cold chain maintenance. Temperature record book is key component for monitoring the temperature regulation.[1,2] At all UHCs documentation of temperature twice daily on regular basis was satisfactory. But documentation record of power failure, defrosting of DF, Technical / mechanical service of DF/ILR etc. was poorly maintained.

Temperature record book was satisfactorily cross checked by Medical Officers (89.3%) but external cross checking by AMC (75%) need some improvement. This may equally be attributed to laxity on part of external supervisors who fail to sign in spite of supervising the system. In the study, data for the temperature monitoring system were collected from different sources, e.g. Digital thermometer temperature, internal thermometer temperature (Alcohol/Dial) and from Temperature record book data. The comparison was done among temperature related data from different sources as shown in Table-3 and Table-4 for ILR and DF respectively. Majority of the temperature were within normal range for the equipment. The recorded temperature was almost similar to the internal temperature measured. As from the above tables (Table-3 & 4) temperature range of internal thermometer of DF and ILR was compared with each other which showed that there was significant difference between DF and ILR for temperature range above normal level (Table-5). But majority of internal thermometer findings shows normal temperature range for both DF & ILR. Overall mean temperature of record book, internal thermometer (Alcohol/Dial) and of digital thermometer was similar (Table-6).

Conclusion and Recommendations :

Although not uniform, significantly higher number of alcohol thermometer is used in ILR whereas dial thermometer in DF. At all UHCs documentation of temperature twice daily on regular basis was satisfactory but other documentation e.g. defrosting status, power failure / cut, technical / mechanical services etc. was poor. Majority of internal thermometer findings shows normal temperature range for both DF & ILR. Regular cold chain training for handlers at UHC level should be organized by the health authority of the AMC area.

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