CHAPTER I
PERFORMANCE AUDIT

Department of Health and Family Welfare

1.1 Prevention and Control of Dengue in National Capital Territory of Delhi

Delhi has been experiencing outbreaks of dengue since 1967 and various steps had been initiated over the years by the government, municipal corporations and other concerned agencies to prevent and control its occurrence as well as provide medical assistance and relief to afflicted persons. However, dengue continues to occur every year with the number of reported dengue cases fluctuating cyclically over the years necessitating commitment of significant financial resources to tackle the problem. A performance audit covering the period January 2013 to December 2015 was conducted to assess whether the steps taken by government agencies and municipal corporations to control dengue were adequate and effective. The Directorate of National Vector Borne Disease Control Program identified eight key elements for prevention and control of dengue. The existing systems and actions taken by the concerned departments/agencies were evaluated against these key elements. The main audit findings are summarized as below:

Highlights

- ***The first critical element for dengue prevention is effective surveillance that could provide early warning of impending outbreak. The three municipal corporations (MCsD) of East, North and South as well as New Delhi Municipal Council (NDMC) had neither developed a Standard Operating Procedure for epidemiological and entomological surveillance nor was there any laboratory facility for this purpose. Consequently, epidemiologists and entomologists were not utilized for their primary purpose of evaluating epidemiological and entomological data to assess risks. Moreover, only 289 out of 967 reporting units (30 per cent) reported data of dengue patients to the State Surveillance Unit thereby undermining its objective of meaningful surveillance enabling timely intervention.***

  (Paragraphs 1.2.1, 1.2.2 and 1.2.3)

- ***Mosquito breeding can be controlled through environment modification that includes solid waste management, proper sanitation and regulation of construction sites, tyre markets, etc. However, no institutional mechanism was in place either in the MCsD or NDMC for collaboration or coordination with other line departments/agencies for environmental modification to control mosquito breeding.***

  (Paragraph 1.3.1)

- ***The municipal corporations deployed domestic breeding checkers to target larvae in houses within their jurisdictions. While NDMC deployed Anti-Malaria Gangmen who were on their regular staff for the purpose, MCsD engaged 3,358 unskilled persons for the task incurring an expenditure of ₹ 109.43 crore. However, there was no monitoring or supervision of the work done or an assessment of their effectiveness.***

(Paragraph 1.3.2)

- ***An expenditure of ₹ 88.26 crore was incurred on procurement of insecticides, diluents and equipment during April 2013 to March 2016 for control of adult mosquitoes. However, in the absence of a definitive policy on use of chemicals and entomological surveillance, there was no system for selecting the most suitable insecticide and techniques to deal with a particular type of situation and identifying localities/ premises where chemicals could be effectively used.***

(Paragraph 1.3)

- ***A total of 83.63 lakh houses were treated with six different types of insecticides applying three different techniques. Of these, 72.07 lakh houses (86.17 per cent) were treated adopting techniques/chemical formulations that are not prescribed or recommended by either the Directorate of National Vector Borne Disease Control Program or the Program Guidelines for Containment of Chikungunya and Dengue Epidemic Outbreak. The expenditure incurred on such treatment was ₹ 2.55 crore. There was also no assessment as to the effectiveness of the methods adopted in vector control.***

(Paragraph 1.3.4.1)

- ***Outdoor space fogging is generally recommended only in emergency situations to suppress an ongoing epidemic or to prevent an incipient one. It is ineffective in most normal conditions. However, MCsD and NDMC undertook outdoor fogging during 2013-2015 as a routine exercise at a cost of ₹ 95.10 lakh. No study was carried out to ascertain the efficacy of the exercise.***

(Paragraph 1.3.4.2)

- ***The formulations used or methods adopted by MCsD and NDMC for chemical control of larvae were not in accordance with those recommended in the guidelines. The Corporations used an insecticide in flowing drains and at a frequency which was not envisaged in the guidelines. The expenditure incurred was ₹ 37.26 crore. In addition, there was no record of usage of insecticides valued at ₹ 79.76 lakh while larvicide valued at ₹ 2.09 crore was used in circumstances that could have been better dealt with by simply mandating regular cleaning of containers in which water was liable to collect.***

(Paragraph 1.3.5)

- ***The Delhi Cantonment Board could not utilize 74 per cent of funds totalling ₹ 1.80 crore allocated for anti-mosquito operations during 2013-14 to 2015-16. No action plan was prepared for fogging and spraying of areas under its jurisdiction nor was there any record of any work actually done.***

(Paragraph 1.3.10)

- ***The institutional arrangements to respond to outbreaks of dengue were weak. The Dengue Task Force constituted to formulate action plans for containment of dengue remained inactive. There was no mechanism in place for reporting outbreaks of dengue and Rapid Response Teams were not constituted in MCsD, NDMC, Northern Railway and Delhi Cantonment Board for taking emergency action to interrupt or reduce transmission and eliminate mosquito breeding sites.***

(Paragraphs 1.4.1, 1.4.2 and 1.4.3)

- ***A Dengue Death Review Committee was to be constituted to carry out medical audit of all dengue cases and guidelines were to be developed by the Directorate of the National Vector Borne Disease Control Program for the Committee. No such guidelines were developed. Out of 67,578 positive dengue cases reported by hospitals, South Delhi Municipal Corporation, as the nodal agency, intimated only 22,436 cases to the Directorate. For the year 2015, while hospitals reported 409 dengue deaths, the Death Review Committee confirmed only 60 deaths.***

(Paragraph 1.5.2)

- ***A Malaria circle is the primary unit from where all field operations are carried out. Over 67 per cent of the Malaria circles lacked basic infrastructure facilities like water connections while 22 per cent lacked electricity connection and 88 per cent lacked a landline telephone which impaired their ability to effectively carry out their functions. About 26 per cent and 65 per cent of available pumps/machines were not functional in MCsD and NDMC respectively.***

(Paragraphs 1.7.2 and 1.7.3)

- ***The Government of Delhi spent ₹ 10.04 crore on awareness campaigns for prevention of dengue during 2013-14 to 2015-16. However, the advertisements were released between September and November i.e. after the outbreak of dengue which defeated the objective of creating awareness of measures to prevent the outbreak. Similarly, the MCsD also started their public awareness campaigns in October every year after the monsoons.***

(Paragraph 1.8.2)

1.1.1 Introduction

Dengue fever is a mosquito-borne viral disease transmitted through the bite of the female *Aedes* (*Ae*) mosquito viz. *Ae Aegypti*, which in its severe form of Dengue Hemorrhagic Fever (DHF) can be life threatening. The first three stages in the life cycle of the *Ae Aegypti* (egg, larvae and pupa) are largely aquatic and typically last for seven to 14 days depending upon ambient temperature and humidity. *Ae Aegyptus* breeds almost entirely in domestic areas around man-made water receptacles. An upsurge in the cases of dengue fever/DHF is generally observed during the months of July to November every year. The World Health Organization (WHO) had identified dengue as one of the 17 neglected tropical diseases in its first report on 'Neglected Tropical Diseases (2010).'

DHF outbreaks have been reported in Delhi since 1967 with a major outbreak in 1996. The number of reported dengue cases and deaths in Delhi during the period 2006-15 has fluctuated with an upsurge during 2015 as depicted in **Table 1.1.1** below:

Table 1.1.1: Reported Cases of Dengue and Dengue Deaths

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dengue cases	3,366	548	1,312	1,153	6,259	1,131	2,093	5,574	995	15,867
Dengue Deaths	33	1	2	3	8	8	4	6	3	60

The Government of India's (GoI) National Malaria Control Program, which was started in 1953, was re-organized in 2004 (10th Plan Period) as the National Vector Borne Disease Control Program (NVBDCP) to include dengue and other vector borne diseases[1]. The program is implemented through the Directorate of National Vector Borne Disease Control Program (the Directorate) as a centrally sponsored State program to be implemented by the States/Union Territories through their respective Health Departments. In 2007, the Directorate issued Program Guidelines for Containment of Chikungunya and Dengue Epidemic Outbreak (Program Guidelines) and also a Long Term Action Plan for prevention and control of Dengue and Chikungunya. A Mid-Term Plan for prevention and control of Dengue and Chikungunya (MTP) was formulated in 2011. These plans are largely based on WHO Guidelines for Diagnosis, Treatment, Prevention and Control of Dengue Fever (WHO guidelines). The Directorate also published Guidelines in 2009 for Integrated Vector Management (IVM guidelines) for control of dengue/DHF.

[1] Japanese Encephalitis (JE), Malaria, Chikungunya, Kala-Azar and Lymphatic Filariasis.

In the National Capital Territory of Delhi, this program is implemented by the Department of Health and Family Welfare of the Government of Delhi (DHFW) and five local bodies[2]. There is a State Program Officer (SPO) in DHFW to implement this program. The Municipal Corporations in Delhi (MCsD) implement the program in their respective jurisdictions through their respective Malaria Department which is a wing of their Public Health Department (PHD) headed by the Municipal Health Officer (MHO). In addition, the Ministry of Railways and the Delhi Cantonment Board also undertake measures to control mosquito population in the areas within its jurisdiction.

Keeping in view the upsurge in dengue cases and higher mortality rate over the years as brought out in Table 1.1.1 above, a performance audit was conducted to appraise the effectiveness of the existing institutional mechanisms to prevent and control outbreak of dengue in the National Capital Territory of Delhi.

1.1.2 Audit objectives

The broad audit objectives of the performance audit were to assess whether:

- preventive steps taken by the GNCTD and local bodies to control occurrence of dengue were effective, in consonance with guidelines issued by the Directorate of National Vector Borne Disease Control Program (DNVBDCP) and commensurate with the magnitude of the problem in NCT of Delhi; and
- Sentinel Surveillance Hospitals (SSHs) were adequately prepared to handle the numbers of dengue patients and whether they adhered to the directives issued by the Government of NCT Delhi (GNCTD) in this regard.

1.1.3 Audit scope and methodology

The performance audit covering the period from January 2013 to December 2015 was conducted from 15 October 2015 to 22 April 2016. Out of a total of 33 Sentinel Surveillance Hospitals (SSH) in NCT of Delhi, Audit selected 10 hospitals[3] of GNCTD and one of East DMC[4] through random sampling for scrutiny of records. In addition, records of two hospitals[5] of the Union Ministry of Health & Family Welfare were examined by the office of the Director General of Audit (Central Expenditure). Two hospitals[6] of the Ministry of

[2] North MCD, South MCD, East MCD, NDMC and Delhi Cantonment Board.
[3] 10 of GNCTD – Lok Nayak Hospital (LNH), Guru Teg Bahadur Hospital (GTBH), Baba Saheb Ambedkar Hospital (BSAH), Deen Dayal Upadhyay Hospital (DDUH), Satyawadi Raja Harish Chand Hospital (SRHCH), Bhagwan Mahavir Hospital (BMH), Dr. Hedgewar Arogyan Sansthan (DHAS), Jag Parvesh Chandra Hospital (JPCH), Sardar Vallabh Bhai Patel Hospital (SVBPH), Pt. Madan Mohan Malviya Hospital (PMMMH).
[4] Swami Dayanand Hospital (SDH).
[5] Lady Hardinge Hospital and Dr. Ram Manohar Lohia Hospital.
[6] Base Hospital and RR Hospital.

Defence along with the Cantonment General Hospital and one hospital[7] of Northern Railway were also audited by the office of the Director General of Audit (Defence Services) and the Director General of Audit (Northern Railway) respectively. Relevant records were also examined at the Directorate of Health Services of GNCTD and the Public Health Departments of NDMC, Delhi Cantonment Board (DCB), Northern Railway and respective MCsD.

Entry conferences were held with the Director Health Services and GNCTD hospitals on 20 November 2015 and with North DMC, South DMC and East DMC on 19 November, 20 November and 4 December 2015 respectively wherein the audit objectives and methodology were explained and discussed. The exit conference with these organizations was held on 2 June 2016 to discuss the audit findings. The views expressed in the exit conference and received subsequently have been suitably incorporated in the Report.

1.1.4 Financial outlay and expenditure

Municipal Corporations of Delhi: Funds for non-plan expenditure are arranged by the Corporations from their own budget while expenditure on plan activities for mosquito control such as procurement of insecticides, equipment, salary of Domestic Breeding Checkers (DBCs), expenditure on public awareness campaigns, etc. is met out of grants-in-aid received from GNCTD. Details of grants-in-aid released by GNCTD and actual expenditure by MCsD on plan activities during 2013-15 are given in **Table 1.1.2.**

Table 1.1.2: Allocation and expenditure (MCsD)

(₹ in lakh)

Year	North DMC		South DMC		East DMC	
	Grants-in-Aid	Expenditure	Grants-in-Aid	Expenditure	Grants-in-Aid	Expenditure
2013-14	3,663.61	3,266.95	3,018.31	2,574.66	1,200.00	1,145.75
2014-15	4,118.66	3,398.54	3,285.65	2,926.17	1,639.25	2,187.91
2015-16	4,642.12	3,923.53	3,515.48	3,316.50	1,688.00	1,654.94
Total	**12,424.39**	**10,589.02**	**9,819.44**	**8,817.33**	**4,527.25**	**4,988.60**

New Delhi Municipal Council: Funds for non-plan as well as plan activities are arranged by NDMC from their own resources. During the period from April 2013 to March 2016, NDMC incurred an expenditure of ₹ 3.81 crore on plan activities.

Delhi Cantonment Board: Details of allocation of funds and expenditure incurred during April 2013 to March 2016 on anti-mosquito operations out

[7] Northern Railway Central Hospital.

of funds arranged by DCB from their own resources are in **Table 1.1.3** as under:

Table 1.1.3: Allocation and expenditure (DCB)

(₹ in lakh)

Year	Budget	Expenditure
2013-14	58.58	8.91
2014-15	35.95	4.63
2015-16	85.98	33.96
Total	**180.50**	**47.50**

Northern Railway: No separate budget allocation was made by Northern Railway for the Chief Health Inspector for anti-mosquito operations. Funds were arranged out of the budget allocation for the Medical Department of Northern Railway.

Audit findings

The Mid-Term Plan (MTP) issued by the Directorate NVBDCP in 2011 stipulates eight key elements[8] for prevention and control of dengue. Audit examined the existing systems in GNCTD, MCsD and NDMC against these key elements and observed inadequacies in program implementation as brought out in the succeeding paragraphs.

1.2 Surveillance

Surveillance is a critical component of dengue prevention and control and requires an active laboratory that can provide early warning of impending epidemic transmission and facilitate civic authorities in deciding appropriate timings for intervention. MTP defines two types of surveillance i.e. epidemiological surveillance and entomological surveillance.

1.2.1. Absence of early warning system for impending disease

Epidemiological surveillance or disease surveillance is ongoing systematic collection, recording, analysis, interpretation and dissemination of data of a disease so that action may be taken to prevent or control it. Audit observed that:

- there was no Standard Operating Procedure (SOP) for epidemiological surveillance and there was no laboratory facility in North and East MCsD and NDMC. In South DMC, a laboratory existed but it was not operational; and
- MCsD had failed to not only collect disease data through epidemiologists for epidemiological analysis but also to utilize critical data of confirmed

[8] Surveillance, Vector management, Capacity building, Monitoring and supervision, Outbreak response, Inter-sectoral co-ordination, Behavior change communication and Case management.

dengue cases provided by hospitals for forecasting the disease, assessing the actual disease burden and planning their anti-dengue activities.

Thus, there was no institutional mechanism to promulgate early warning of impending disease.

South DMC stated (May 2016) that entomologists regularly kept surveillance on relevant vectors while North DMC asserted that epidemiologist surveillance was being carried out for suspected and confirmed dengue cases. East DMC stated that there was no need for epidemiological surveillance as it had very limited terrain. The replies are not tenable as (i) epidemiological surveillance relates to dengue patients/epidemic which is to be carried out by epidemiologists (study of transmission and control of epidemic diseases) and not by entomologists (study of insects), (ii) North DMC merely collected the data of houses treated with chemicals which cannot be deemed as epidemiological surveillance, and (iii) the response of East DMC ignores the fact that the need for surveillance is not related to the size of the terrain but its vulnerability to conditions conducive to vector breeding.

1.2.2 Lack of mechanism required for control of mosquito population

Entomological surveillance is used for operational research purposes to determine changes in geographical distribution of vectors for monitoring and evaluating control programs, obtaining relative measurements of the vector population over time and facilitating appropriate and timely interventions. The entomological parameters prescribed by the MTP-2011 include vector surveillance[9] and larval surveillance[10].

After the dengue epidemic in 1996, Government of India (GoI) decided in March 1997 to establish Entomology Units in each of the 12 zones of MCsD and appoint one entomologist in each of the zones. Subsequently, eight entomologists were appointed in July 1997 on contract basis. As of December 2015, there were 11 entomologists to organize vector surveillance, ensure the efficacy of insecticide, check the parasite susceptibility of vector and to build up the Department of Entomology.

However, since the entomology units and entomological laboratories were not established nor were standard operating procedures for functioning of entomologists developed, the appointed entomologists were deployed on other tasks such as checking different premises for domestic breeding. In the absence of an entomological surveillance system, MCsD and NDMC were not in a position to assess changes in geographic distribution of vectors and severity of

[9] Vector surveillance determines adult mosquito density and an index is calculated for each vector species. It includes determining per man hour density and per room density of mosquitoes.

[10] Larval surveillance is used to determine the density of larvae. Houses are the basic sampling units which are systematically searched for water holding containers.

an outbreak in a particular area and initiate appropriate and timely institutional intervention to control mosquito population and intensify public awareness.

While North and South DMCs stated (May 2016) that there was a beat wise daily schedule for checking breeding, East DMC and North DMC stated that laboratory facilities were being set up.

1.2.3 Incomplete Integrated Disease Surveillance Program

GNCTD decided to collect data relating to dengue in its Integrated Disease Surveillance Program (IDSP) portal for disease surveillance. However, out of 967 reporting units (933 private hospitals/nursing homes and 34 government hospitals), only 289 units (30 *per cent*) reported the data of dengue patients to the State Surveillance Unit, set up under IDSP, during the year 2015. The State Program Officer (SPO) made no efforts to collect data from the remaining units. The Department informed that the State Surveillance Unit evaluated the effectiveness of prevention and control program by examining the data. However, no documentary evidence was provided to audit in this regard. In the absence of complete data from all the reporting units and non-availability of trained manpower, the objective of meaningful and effective surveillance like timely detection of epidemics, monitoring trends in spread of dengue and measuring the burden of disease was not achieved.

1.2.4 No vector surveillance even in hospital premises

Each selected hospital vouched to become zero tolerance zone by enhancing sanitation and vector surveillance activities within their premises. However, the Directorate inspected hospitals during July and August 2015 and found larvae of dengue mosquito in their premises. None of the hospitals furnished report of the inspection and action taken thereon. Though in a meeting held in August 2015, Secretary, GNCTD directed for constitution of Dengue Surveillance Committee in each hospital to check the mosquito breeding, yet report of these committees were not submitted to higher authorities.

1.2.5 No arrangement for operational research

The Long Term Plan 2007 and WHO guidelines stipulate that operational research should be oriented to the priority needs of the program in order to generate evidence base for adaptation of strategies and interventions. This may include studies on the ecology of the vector, the efficacy, effectiveness and cost-effectiveness of existing and new vector control methods, formative research on relevant cultural practices and guidance for engaging communities in program activities. Action plans of MCsD 2013 for prevention and control of vector borne diseases envisaged that operational research projects would be initiated in collaboration with the National Institute of Malaria Research (NIMR), the National Centre for Disease Control (NCDC), NVBDCP, medical colleges and non-governmental organisations. However, no initiative was taken by the MCsD in this direction and there was no arrangement for studies on

local ecology of vector and the efficacy, effectiveness and cost-effectiveness of existing vector control methods in order to generate an evidence base for adaptation of strategies and interventions.

MCsD stated (May 2016) that operational research was the domain of central government research institutes. The reply is not tenable since it was the responsibility of the MCsD as per their own Action Plans to initiate operational research in collaboration with central government research institutes.

1.3 Vector Management

According to WHO guidelines, prevention or reduction of dengue virus transmission was dependent entirely on control of mosquito vectors and interruption of human-vector contact. Actions to control transmission should target *Ae Aegypti* in its habitats in households and other settings where human-vector contact occurs. The importance of such measures was illustrated when MCsD failed to carry out its annual exercise of spraying adulticide in all school buildings, community centers, public halls, underground parking sites, JJ clusters, river belts, etc. during the year 2015 and the number of dengue cases spiked to 15,867 with 60 mortalities.

The main emphasis of a vector management program should be on control of mosquito population through (i) source reduction by way of environment modification and manipulation, (ii) chemical control for larval and adult control and (iii) legislation for effective enforcement.

MCsD and NDMC incurred an expenditure of ₹ 88.26 crore on procurement of insecticides, diluents and equipment during April 2013 to March 2016. Of this, insecticides valued at ₹ 43.65 crore were used for fogging and spraying operations during the same period.

1.3.1 Source reduction through outdoor environmental modification

As per WHO guidelines, *Ae Aegypti* uses a wide range of larvae habitats, both man-made and natural. Control efforts should target the habitats that are most productive and epidemiologically important. MCsD and NDMC identified the following primary causes creating conditions suitable for mosquito breeding:

(i) Inadequate solid waste management particularly of discarded containers such as plastic glasses, packing containers, etc. in which rain water collects providing favourable conditions for mosquito breeding.

(ii) Poor sanitation conditions and absence of adequate drainage systems resulting in water stagnation that becomes prominent breeding sites.

(iii) Unregulated construction sites that provide favourable conditions for mosquitoes breeding in water storage tanks, buckets, rubbish bins, pits and other cavities.

(iv) Un-sheltered used tyre storage sites and workshops in different parts of the city that are highly productive larval habitats.

(v) Irregular or no piped water supply which compel households to store water in containers/tanks that are suitable sites for mosquito breeding.

Mosquito breeding can be controlled through environment modification. Issues relating to solid waste management, adequate sanitation arrangements, proper regulation of construction sites and tyre markets are the subject matter of MCsD and NDMC which need to be addressed through a well-knit collaboration among their own wings such as the Department of Environment Management and Sanitation and the Building and Health Departments. Matters relating to regular piped water supply can be taken up with Delhi Jal Board. However, no institutional mechanism was in place either in MCsD or NDMC to ensure necessary collaboration amongst their wings and other line departments of GNCTD for environmental modification to control mosquito breeding.

South and East DMC stated (May 2016) that inter-sectoral co-ordination meetings were held involving their own wings and other line departments for environmental modifications. North DMC stated that efforts were being made for sensitization of all stake holders. However, the fact remained that the efforts made so far has had little perceptible impact.

1.3.2 Monitoring of domestic breeding checkers

Ae Aegypti mosquito normally breeds in domestic/peri domestic conditions. Water storage vessels, flower vases, potted plants with saucers, blocked roof gutters, discarded buckets and used tyres are prominent breeding sites inside a house.

While Northern Railway had a robust system for checking mosquito breeding by Domestic Breeding Checkers (DBCs) and monitoring and supervision of the activities of DBCs by supervisory staff of its Health department, there were many inadequacies in the system followed by the MCsD. The Municipal Corporations contracted unskilled persons as Domestic Breeding Checkers (DBCs) who were to target larvae in their habitat by visiting every house. As of December 2015, MCsD had 3,358 DBCs in their 12 zones covering 67.36 lakh houses and incurred an expenditure of ₹ 109.43 crore for the period from April 2013 to March 2016. NDMC gets the checking of domestic breeding done through Anti-Malaria Gangmen (AMG) who are part of their regular staff. MCsD and NDMC fixed a norm for DBCs/AMGs to visit at least 50 houses per day for checking each and every water holding container including overhead water tanks and carrying out anti-larvae measures.

Audit observed as follows:

- Incubation period of a mosquito egg is at least seven days. Going by the norm set by MCsD and NDMC, there was a requirement of 22,453 DBCs to visit all the houses in NCT of Delhi at an interval of six days. Given the existing number of DBCs, it is not possible for a DBC to re-visit a house before 44 days.
- In case a house owner denies entry to his house or a house is found locked for any reason, DBC/AMG would leave the premises unchecked for mosquito breeding. Thus, there remains a possibility of gaps in detection of dengue in that locality.
- Domestic breeding checking requires regular combing of the locality with comprehensive mapping and indexing of houses. But no systematic data was maintained by MCsD and NDMC. In the absence of such data, it may not be possible to systematically undertake anti-larval activities in a locality.
- There is no system to supervise and monitor the work of DBCs or to collect feedback from the households on the work actually done by DBCs.
- MCsD and NDMC had never evaluated the effectiveness of DBCs/AMG in controlling indoor mosquito breeding and there was no feedback as to their work from the targeted areas.

Inadequate number of DBCs coupled with lack of any systematic mapping and monitoring of the actual checking done by them provides no assurance as to the effectiveness of their checking and eliminating mosquito breeding in domestic houses. It was further noted that though the necessity of DBCs is only for six months i.e. from June to November, the MCsD hired them for the whole year.

Accepting the facts, MCsD stated (May 2016) that the role and responsibilities of DBCs would be enhanced.

1.3.3 Use of insecticides without ascertaining their susceptibility

The WHO guidelines state that insecticide resistance must be considered as a potentially serious threat to effective dengue vector control. The initial and continued susceptibility of vector to specific insecticides is of fundamental importance for the success of larviciding or adulticiding operations. The Manual for Malaria Technical Supervisors and IVM of NVBDCP stipulate that the choice of insecticides must be based on susceptibility testing which should be carried out every second year in one locality. Though MCsD and NDMC had been relying on chemicals to control the mosquito population, the chemicals used were never tested for susceptibility to ensure their continued efficacy.

East DMC stated (May 2016) that as Central Government Institutes undertake the susceptibility testing there was no need to re-check. However, East DMC

did not produce any evidence that susceptibility test of insecticides were ever tested by Central Government institutes. South DMC stated that insecticides used were tested in approved lab before their use. North DMC stated that entomological labs were being upgraded to carry out such tests.

1.3.4 Chemical control for adult mosquitoes

1.3.4.1 Deviations from prescribed techniques for spraying and fogging

As per NVBDCP guidelines, chemical sprays are not effective in most conditions and it is rare that an epidemic would be controlled by using these methods. In the last three years, MCsD and NDMC chemically treated 79.15 lakh and 4.48 lakh premises respectively using six different types of synthetic insecticides and applied three different techniques i.e. Insecticidal Residual Spray (IRS), Indoor Space Spray and Indoor and Outdoor Space Fogging. However, details of the premises treated with chemicals such as name of the owner of house, house number, address, type of premises and reasons for resorting to chemical treatment were not maintained by the MCsD and NDMC. An analysis of techniques used by MCsD and NDMC for chemical treatment to kill mosquitoes inside houses revealed the following:

(i) Insecticidal Residual Spray (IRS)

The Directorate prescribes this technique of vector control in rural settings only. The Directorate did not prescribe adoption of IRS for Delhi. However, MCsD and NDMC adopted this technique to treat 13.79 lakh houses during January 2013 to December 2015 at a cost of ₹ 1.12 crore. The reasons and circumstances under which this non-prescript technique was used were not on record.

Further, the Directorate stipulated that IRS, being a technical task, should be carried out by trained persons with Stirrup Pumps[11]. Audit noticed that out of 12.52 lakh houses treated with IRS by South and North DMC, Knapsack Pump instead of Stirrup Pump was used in 8.97 lakh houses. NDMC also did not use Stirrup Pump for IRS. As proper technique was not used for IRS, it could not be ascertained whether the desired results were achieved.

The Directorate prescribed a protocol to be followed for concurrent and consecutive supervision for IRS. Nothing was on record to establish whether officials at supervisory levels had verified the quality and coverage of spray through IRS as specified in the guidelines.

(ii) Indoor Space Sprays

In this technique, a solution of pyrethrum is sprayed in indoor conditions with hand operated pumps with micro discharge nozzles. Program guidelines state

[11] Stirrup Pumps with spray nozzle tip having the discharge rate of 740 to 850 ml per minute and 10-15 cm plunger movement at a pressure of 10 PSI.

that chemical space sprays are not effective in most conditions and it is rare that an epidemic will be controlled by use of these methods. While NDMC did not use this technique, MCsD treated 11.51 lakh premises during January 2013 to December 2015 with this technique using 9,508.04 litres of pyrethrum costing ₹ 1.43 crore.

It was further noticed that though the guidelines and IVM prescribe use of the pyrethrum mixed in kerosene for indoor spray, North DMC sprayed pyrethrum diluted with diesel in 3.64 lakh (50 *per cent*) out of 7.22 lakh houses. Spraying houses with solution of pyrethrum and diesel was a deviation from prescribed norms. The Directorate confirmed to Audit in July 2016 that pyrethrum can only be used with kerosene in indoor sprays as distinct from indoor fogging with diesel.

Further, program guidelines prescribe periodic indoor space sprays to achieve the desired results. But no record was maintained to indicate the number of houses where indoor spray was repeated nor was any study conducted to ascertain the impact of this technique on the mosquito population**.**

(iii) Indoor fogging

IVM prescribes a formulation of pyrethrum and kerosene for indoor space fogging through hand held fogging machine. Program guidelines state that this formulation is a natural product and non-toxic to humans and other non-target organisms and that vectors had not developed resistance to this formulation. Pyrethrum is also widely regarded as more environment friendly as it was relatively bio-degradable. The Directorate clarified to Audit in July 2016 that pyrethrum with diesel can be used for indoor fogging and not malathion. It was however noticed that while NDMC carried out indoor fogging of pyrethrum with diesel in 3.69 lakh houses, MCsD deviated from this formulation and carried out indoor fogging in 54.64 lakh houses with a formulation of malathion with diesel instead of using pyrethrum and kerosene which is prescribed for such indoor fogging.

1.3.4.2 Outdoor fogging

WHO guidelines recommend outdoor fogging only in emergency situations to suppress an ongoing epidemic or to prevent an incipient one. Program guidelines state that chemical space spray is not effective in most conditions and fogging often creates a false sense of security. The Program guidelines defines two techniques for outdoor fogging when it is to be used viz. (i) thermal fogging by a vehicle mounted thermal fogging machine using a mixture of Malathion and Diesel and (ii) Ultra Low Volume Spray (ULV) of any of organo-phosphorous insecticide. The guidelines recommend water

based ULV of liquid insecticide as being more cost effective than thermal fogging since no diluent is used in this technique.

MCsD and NDMC undertook thermal outdoor fogging during the dengue season in the years 2013 to 2015 at a cost of ₹ 95.10[12] lakh as a routine exercise without exploring the possibility of adoption of ULV spray which is more cost effective. Further, no study was carried out by the MCsD and NDMC to ascertain the efficacy of the thermal fogging.

South and North DMC stated (May 2016) that outdoor fogging was carried out mainly during outbreak like situation and was not a regular exercise. The reply is not factually correct as records of both corporations established that fogging exercise was carried out regularly during the period from September to November in the last three years. East DMC confirmed that outdoor fogging had limited effect and it was an appeasement exercise which was undertaken as per demand/complaint/media coverage. The replies were silent on the issue of not adopting the ULV technique for outdoor treatment.

1.3.5 Chemical control for larvae

WHO guidelines prescribe that larvae habitats should be treated with chemicals only if environmental management methods or other non-chemical methods cannot be easily applied or are too costly. IVM states that application of chemicals is difficult and expensive on a long term basis and therefore chemical larvicides are best used in situations where vector surveillance indicate the existence of certain periods of high risk and in localities where outbreaks might occur. Audit observed the following:

(i) Injudicious and excess application of chemical

Bacillus Thuringiensis Israelensis (BTI) is used as larvicide for biological control of larval stages. BTI is sprayed on water having already developed larva killing it in 24 to 48 hours. BTI solution destroys already developed larva and is not meant to prevent breeding. Audit noticed that BTI was being regularly sprayed on flowing water in drains without ensuring presence of larvae instead of ensuring their cleanliness through environmental modification methods. Moreover, the prescribed frequency for applying BTI is once in two weeks whereas MCsD were applying this chemical on weekly basis resulting in excess usage of this biological agent. During January 2013 to December 2015, MCsD and NDMC used 553.14 tons and 5,765 liters of this larvicide in small drains in residential colonies at a cost of ₹ 37.26 crore.

Since neither WHO nor the program guidelines envisaged use of BTI in drains nor had the corporations carried out any study to ascertain its impact on

[12] Includes cost of Malathion used in indoor fogging.

mosquito population in and around the areas sprayed, its utility or effectiveness could not be established.

South and North DMC confirmed (May 2016) that BTI was sprayed on flowing drains while East DMC accepted (May 2016) that no larvicide was to be sprayed on free flowing water of drains and field workers were supposed to spray on the polluted water mainly on the banks of water bodies once a week.

(ii) No records kept of use of a larvicide

Temephos EC 50 *per cent* is a larvicide sprayed on water having already developed larva. During January 2013 to December 2015, MCsD and NDMC used 11,684 liters and 1,306 liters Temephos EC 50 respectively incurring an expenditure of ₹ 79.76 lakh. However, no record was maintained of locations and circumstances under which this larvicide was used.

(iii) Use of unapproved Temephos granules

WHO prescribes that larviciding should be considered as complementary to environment management and should be restricted to containers that cannot otherwise be managed. Use of Temephos granules is not approved for the program by the Directorate. However, MCsD and NDMC issued 345.50 tons and 4.46 tons of it respectively to DBCs/AMGs to be applied in household water containers, money plants, flower vases, overhead tanks, bird pots, discarded tyres, air coolers etc. during the period from January 2013 to December 2015 although these containers could have been managed by simply draining the water out of them and periodically refilling them with fresh water. The expenditure incurred on this was ₹ 2.09 crore. No study was conducted to assess the impact of this larvicide on mosquito population.

1.3.6 Vector control was not an integrated exercise

Destroying adult mosquitoes and destroying of larvae are complementary to each other. Both exercises should be taken up simultaneously for effective vector control. Though MCsD and NDMC had carried out insecticidal residual spray, space focal spray and indoor fogging in 83.63 lakh houses between January 2013 and December 2015, there was nothing found on record to indicate that larviciding had also been undertaken simultaneously. Killing mosquitoes without destroying larva and vice versa is an incomplete vector control exercise and dilutes the effectiveness of the entire effort.

1.3.7 No action to eliminate breeding sites identified by DNVBDCP

Cross Checking Organization (CCO) of the Directorate undertakes random exercises to independently check breeding of mosquitoes in different parts of NCT of Delhi and sends its reports on locations where breeding was detected to the concerned officials to take appropriate action. Audit however noticed

that no records of action taken on the report of CCO were being maintained nor had the Directorate pursued the matter as a measure of monitoring and oversight.

1.3.8 No assurance of quality of insecticides procured

Insecticide being used by MCsD and NDMC are recommended by the WHO for use in public health with the stipulation that the recommendations are valid only if linked to WHO specifications as to quality control. South DMC and North DMC had been procuring insecticides through a consultant since 2006. As per the consultancy agreement (17 March 2006), the consultant was to ensure quality compliance with technical specifications and parameters by conducting inspections at pre and post-dispatch stage of the consignment of insecticides in accordance with the prevailing Drug and Cosmetics Act, 1940, and the Pharmacopoeia, Standards and Insecticide Acts and Rules. The consultancy agreement further provides that samples drawn during the pre/ post-dispatch inspection will be tested only at the Sri Ram Institute of Industrial Research (SRIIR). However, the agreement did not mention the procedure of taking the sample and the person authorized to take such sample. It was noticed that though samples were sent to SRIIR by the consultant before dispatch of the consignment, these were not drawn in the presence of officers either from South DMC, North DMC or SRIIR. Test reports of SRIIR submitted by the consultant also did not have the name of person who took the samples. Thus, there was no assurance that samples tested by the SRIIR were from the consignment that was actually delivered to MCsD. It was further noticed that no sample was drawn or tested at post-dispatch stage or at the time of receiving the consignment by South DMC and North DMC. However, East DMC and NDMC sent samples at post-dispatch stage.

1.3.9 Vector control through legislation

MTP-2011 provides that the plan for prevention of dengue should be supported with legislation and suggests measures for dengue control in urban areas by introducing necessary building bye-laws. Audit observed that:

- Annual Action Plan of MCsD of 2013 mentioned that existing building bye-laws should be revised on the pattern of the Mumbai Municipal Corporation Act, 1928, where owners of houses are compelled to make necessary arrangements for keeping their premises free from mosquito breeding.
- A high level meeting held on 18 March 2015 decided to revise the building bye-laws on the Mumbai pattern and to increase the penalty of ₹ 500 to ₹ 5,000 to be charged from the owners of premises where mosquito breeding is detected.
- Annual Action Plan also mentioned that section 269 of the Indian Penal Code should be invoked for legal actions against regular offenders for creating/encouraging mosquito breeding conditions.

However, no action was initiated on the above proposals. MCsD and NDMC did not even consistently impose the existing penalty on offenders. Out of a total of 6,06,257 houses found with mosquito breeding, only 65,545 (11 *per cent)* were challaned. Similarly in NDMC, challans were issued in only 7.65 *per cent* of positive breeding cases.

Absence of enabling legislative provisions to compel owners to keep their premises mosquito free coupled with lack of enforcement of even existing provisions that could act as a deterrent undermined effective vector control and efforts to eradicate dengue.

1.3.10 Preventive measures in areas with Cantonment Board and Railway

Scrutiny of the records of Chief Health Inspector/Malaria, Delhi Main under Northern Railway revealed that a roster was maintained and area wise teams were deputed to carry out fogging and spraying on daily basis to cover all Railway premises. In addition, fogging and spraying was done immediately as and when any information or report was received regarding a confirmed dengue case in railway colonies. Survey of the houses of railway colonies was also conducted along with the officials of Municipal Corporation of Delhi and challans were issued to defaulters during the monsoon season.

Pursuant to a decision (May 2012) of the Inter sectoral co-ordination committee that Northern Railway would run special trains in the month of July every year for anti larval measures, a special train with power spray for anti-larval measures along the railway track had run during the years 2013 to 2015 during the period from August to October.

Insofar as the Delhi Cantonment territory is concerned, the Station Health Officer (SHO) is responsible for anti-mosquito operations in areas occupied by serving defence personnel while the Delhi Cantonment Board (DCB) caters to the 0.82 lakh civilian population living in the Cantonment area. While SHO took the requisite measures for mosquito management in his jurisdiction, action on the part of the DCB was lacking. DCB could utilize only about 26 *per cent* of its budget allocation for anti-mosquito operations during the three years (as depicted in Table 1.1.3). DCB did not prepare any annual program during the years 2013-2015 for fogging and spraying of insecticides in the civilian area under its jurisdiction nor were any details of fogging actually done and premises treated maintained. No action plan was prepared for source reduction to eliminate mosquito breeding nor was any report on reduction of mosquito breeding sent to the Directorate.

Thus, while necessary steps had been taken by the Northern Railway, preventive measures undertaken by MCsD and the Delhi Cantonment Board did not provide any assurance as to their effectiveness.

1.4 Response to Outbreaks

1.4.1 Inactive Dengue Task Force

A Dengue Task Force was constituted by GNCTD in November 2012 under the Chairmanship of Secretary (Health) GNCTD with Director of Health Services, GNCTD and MHO, SDMC as Vice Chairmen. Additional Director (Public Health), GNCTD, MHOs of North/East MCD and NDMC and SHO of Delhi Cantonment Board were its members. The Task Force was to formulate action plan for containment of dengue and other vector borne diseases in NCT of Delhi. However, Audit noticed that neither any action plan for containment of dengue and other vector borne diseases was finalized by this Task Force nor any meetings or activities undertaken in 2014 and 2015.

1.4.2 No mechanism for reporting of outbreak of dengue

The Long Term Plan defines the term "outbreak of dengue"[13] and prescribes that on receipt of the report of occurrence of fever, the medical officer/zonal health officer would visit the affected area to conduct epidemiological investigations to find out the probable causes of fever and to collect 5-10 *per cent* blood samples randomly from the affected population to send to Sentinel Surveillance hospitals for serological/virological confirmation. Fifty *per cent* of the serum samples received by the hospital would be transported to the apex referral laboratory for virological diagnosis. In case any blood sample is found positive for dengue by the SS hospital laboratory or the apex referral laboratory, the locality would be declared as having outbreak of dengue. However, no such mechanism was developed in GNCTD/MCsD/NDMC.

1.4.3 Rapid Response Teams not constituted

MTP 2011 stipulates that outbreak of arboviral diseases like dengue require quick emergency action to immediately control infected mosquitoes in order to interrupt or reduce transmission and reduce or eliminate the mosquito breeding sites. MTP also suggests constitution of a Rapid Response Team (RRT) comprising of epidemiologists, entomologists, microbiologists and Information, Education and Communication personnel to take the following steps on receipt of report of a suspected or confirmed case from a Sentinel Surveillance Hospital (SSH):

- Confirm whether any case was reported earlier from the area andanalyze/ compare the previous and current data; and
- Visit the area as early as possible to collect information on cases, their clinical signs/symptoms, history of exposures and other relevant epidemiological/entomological and laboratory information to substantiate the outbreak.

[13] An outbreak of fever would be considered if the number of fever cases of similar nature reported by health workers are five or more in a locality having population 10-15 thousand during a period of seven days.

It further provides that the findings should be communicated to the State/ District Vector Borne Disease Control Program and the Municipality Health Officer for implementation of control measures. However, no RRT was constituted in MCsD and NDMC. No mechanism was in place to plan anti-mosquito activities and there was no system to assess the disease burden to judge whether it is an epidemic or isolated occurrence of the disease.

In Northern Railway also, no RRT was formed although 64 cases of dengue fever in 2013-14, 24 cases in 2014-15 and 339 cases in 2015-16 were reported in the Central Hospital, Northern Railway. Similarly no RRT was formed in the Delhi Cantonment Board.

1.4.4 Hospitals not equipped for testing the dengue virus during outbreak

As per the Long Term Action Plan, each SS Hospital should have an Elisa reader, Elisa washer and other necessary equipment for dengue serology. In case equipment are not available, SPO should immediately arrange for the same in consultation with the Directorate of NVBDCP to ensure availability of these facilities in the hospitals. It was observed that in Pt. MMM Hospital[14] and Satyawadi Raja Harish Chandra Hospital, one Elisa Reader remained non-functional since 2013. These hospitals purchased new Elisa Reader each only in September and October 2015. In another instance, BSAH[15] purchased Elisa Micro Plate Reader on 22 September 2015, but the same was issued to Microbiology Lab 66 days after its receipt i.e. on 28 November 2015. Thus, these three hospitals were not fully equipped for testing the dengue virus in patients when the outbreak was at its peak. It is only when the outbreak was receding that these hospitals received the machines.

1.4.5 Inadequate facilities in Railway and Cantonment Board Hospitals

Bed nets, mosquito repellent were not provided to dengue patients in the Central Hospital, Northern Railway, to prevent spreading of dengue virus from infected persons to non-infected ones.

There are three hospitals of the Ministry of Defence functioning in the Cantonment area in NCT. While the Base Hospital and Army Hospital are for the treatment of service personnel, the Cantonment Board Hospital provides medical facilities to the civilian population residing in the cantonment area. Both the Base Hospital and Army Hospital were appropriately equipped and staffed for treatment of dengue patients. However, the Cantonment Board General Hospital lacked any facility for indoor patient treatment. A total of 353 patients detected by this hospital as positive dengue cases in 2015 were treated in Outdoor Patient Department (OPD) or referred to other Government Hospitals.

[14] Pandit Madan Mohan Malviya Hospital.
[15] Baba Saheb Ambedkar Hospital.

1.5 Monitoring and Supervision

1.5.1 No mechanism for supervision and monitoring

Municipal Health Officers (MHOs) of respective MCsD are overall in-charge of Public Health Departments divided into 12 zones with a Deputy Health Officer (DHO) heading each zone. Zones are further divided into circles which is the primary unit for field work. However, there was no mechanism or prescribed procedure for supervision and monitoring of anti-mosquito activities undertaken by the field staff at circle levelby the MHOs or other authorities. MCsD and NDMC maintained no record of the observations made by MHO or of any directions issued to the field staff.

Moreover, MCsD and NDMC did not develop a mechanism to take feedback from public on the anti-larval work done by the DBCs/AMGs or the work done by field workers in their respective beat. In the absence of proper supervision by the management and a feedback from the public, there is no method for an empirical periodic evaluation of the level of effectiveness and efficiency of the anti-mosquito measures taken by MCsD.

1.5.2 Under reporting of dengue cases and dengue deaths

South DMC, as the nodal agency in NCT of Delhi, collects data of positive dengue cases from the hospitals for further transmission to Government of India (GoI). The exercise facilitates GoI in assessing the actual disease burden. Details of the positive cases reported by hospitals to the nodal agency and the cases actually further intimated by the nodal agency to the Directorate during the last three years are depicted in **Table 1.1.4**:

Table 1.1.4: Cases reported by Hospitals and those intimated to Directorate

Year	Positive cases reported by hospitals	Cases intimated to the Directorate
2013	23,451	5,574
2014	4,596	995
2015	39,531	15,867
Total	**67,578**	**22,436**

Out of the total 67,578 cases reported by hospitals, the nodal agency reported only 22,436 cases (33 *per cent*) to the Directorate. Remaining cases were deleted on various grounds such as cases which were tested positive through Rapid Kit Test (11,345 cases), cases where complete address was not available (2,564 cases), cases declared suspected by hospitals (13,417 cases), cases not traceable (4,140 cases), cases where patients acquired the infection from other States (1,711 cases), cases which pertained to other States (2,611 cases) and cases where addresses were of other States (9,354 cases).

The Action Plans of 2014-15 and 2015-16 for prevention and control of vector borne diseases in Delhi stipulated that a Dengue Death Review Committee would be constituted to carry out medical audit of all dengue cases. Guidelines for this Committee were to be developed by the Directorate of NVBDCP. Action plan further stipulated that dengue death should be notified only after it had been confirmed by the Dengue Death Review Committee. It was, however, noticed that neither DNVBDCP developed the guidelines nor did GNCTD pursue the matter with DNVBDCP. During 2015, hospitals reported 409 dengue deaths to the nodal agency who in turn forwarded these cases to the Dengue Death Review Committee. Out of these 409 death cases, the Committee confirmed only 60 deaths (46 from Delhi and 14 from outside Delhi) as dengue deaths. In 2014, nodal agency sent 50 dengue death cases, but Committee confirmed only three cases. In the absence of any criteria/guidelines for the Committee to review the reasons for death, it is not clear how the remaining deaths were not considered as dengue deaths though these were confirmed by the hospital as dengue deaths.

In 2015, out of 967 medical units (933 private hospitals and Nursing Homes and 34 Government Hospitals) which were required to report the dengue cases/ dengue deaths to SDMC, only 27 SSH and 43 private hospitals and nursing homes reported dengue positive cases and death cases to nodal agency. But the nodal agency made no arrangement to collect data from the remaining private hospitals and nursing homes. Thus, the disease data communicated by the nodal agency to the Directorate was incomplete and could not be said to be comprehensive or reliable.

South DMC stated (May 2016) that details of dengue cases on being received from hospitals are investigated by the concerned civic body and only those cases which belong to Delhi are considered as positive dengue cases.

1.5.3 Delay in reporting of severity of impending disease

DENV-1 and 3 cause mild dengue with high morbidity and low mortality. DEN V-2 and 4 are known as the more virulent serotype among the four and cause complications and high mortality. The Directorate identified the National Center for Disease Control (NCDC) and the All India Institute of Medical Sciences (AIIMS) Delhi as Apex Referral Laboratories (ARLs) for virus isolation of dengue in Delhi. As per the advisory issued to all ARLs by NVBDCP on 29 May 2013, ARLs were responsible for providing information about the circulating dengue serotypes/genotypes in linked States. In a meeting held on 8 May 2014, it was decided that ARLs would carry out viral serotyping in the beginning of the transmission period and reports would be shared with all the implementing agencies for wider circulation among the clinicians. However, it was noticed that both the ARLs of Delhi reported the serotypes in September 2015 when epidemic had already broken out in Delhi. Had ARLs

submitted their reports timely, health authorities would have been able to assess the severity of impending disease and make timely preparations.

Moreover, the Union Ministry of Health & Family Welfare instructed (February 2015) that all SSHs should collect blood samples from suspected patients with fever syndrome and process on a timely basis for serologic confirmation. Further, as per the Action Plans 2014 and 2015, all SSHs were required to test 10 *per cent* of fever cases for dengue during non-transmission period for disease forecasting. Audit observed that neither of these instructions were followed by hospitals in 2015 nor had any mechanism been developed by GNCTD to ensure compliance by hospitals to these instructions. Only when Dean, Maulana Azad Medical College Delhi requested the Medical Superintendent, Lok Nayak Jai Prakash Narayan Hospital Delhi in October 2015 to submit Positive Cases Reported (PCR) samples for serotypes of dengue patients which would help in determining the profile of dengue fever/strain did DHS forward the request to several other hospitals on 19 October 2015. Hence, there was clearly a lack of diligent observance of the instructions issued by GoI.

1.6 Inter-sectoral Coordination

Public Health Department, South DMC organized workshops every year jointly with East DMC, North DMC and NDMC on prevention and control of vector borne disease in Delhi and brought out a document highlighting the measures to be taken to control and prevent vector borne diseases. In these workshops, several decisions are taken which are to be implemented by various implementing departments. Audit observed that 38 out of 138 decisions taken in the workshop held in 2015 were to be implemented by MCsD themselves, 22 by all civic bodies, three by Delhi Government departments, one by departments of Government of India, five by South DMC and 11 by Sentinel Surveillance hospitals. Fifty-eight decisions were to be implemented by more than one agency including all MCsD, GNCTD Departments and civic bodies. Audit observed that no arrangements were made to monitor compliance of these decisions nor was there any Action Taken Report from the concerned departments on the implementation of the decisions taken at the workshop. Moreover, there was no evidence that MCsD and NDMC themselves initiated action on the decisions which were identified to be implemented by them.

1.7 Capacity Building

1.7.1 Inadequate organizational structure

MCsD were implementing the National Anti-Malaria Program (NAMP) through their Malaria Department (MD). Though both malaria and dengue are spread by mosquitoes, they are different diseases. Malaria is a parasitic disease whereas dengue is an arboviral disease. Therefore, inclusion of viral diseases

like dengue in the program of MD required re-structuring to make it capable of tackling dengue and other viral diseases. However, no such change in structure of MD was effected. There are posts of Anti Malaria Officer (AMO) in each zone of the Public Health Department (PHD) to implement and supervise anti-malaria activities but no corresponding posts for dengue or other viral diseases. Similar position prevailed in NDMC also.

1.7.2 Lack of adequate infrastructure

A Malaria Circle is the primary unit from where all field operations are carried out to implement the program. A survey of all the 292 circle offices of MCsD showed that even basic infrastructure/facilities were not available in most of the offices. Some instances are given in **Table 1.1.5** below:

Table 1.1.5: Circles with Inadequate Infrastructure/Facilities

Sl.No.	Lack of infrastructure/facilities	No. of circles
1.	Electricity connection	64 (22%)
2.	DJB water connection	195 (67%)
3.	Proper office accommodation	76 (26%)
4.	Ceiling fan and lighting arrangement	70 (24%)
5.	Toilet and washroom facilities	97 (33%)
6.	Storage space for chemicals and insecticides	167 (57%)
7.	Space for storing empty containers	176 (60%)
8.	Landline telephone	258 (88%)
9.	Sweeping and cleaning arrangements	177 (61%)

It was observed that:

(i) Though BTI is the most widely used chemical in MCsD and is mixed with water to prepare a solution, 67 *per cent* of circles did not have water connection.

(ii) About 88 *per cent* of circles did not have telephone facility to keep in touch with public or senior officers and 22 *per cent* were without electricity connection.

(iii) Proper office accommodation was not available in 26 *per cent* of circles and toilet facilities were not available in 33 *per cent* of circles.

(iv) DNVBDCP guidelines define a protocol for transportation and storage of insecticides and disposal of remains of insecticides and empty packing. Zonal offices of MCsD are situated at a distance of one to 25 kms from PHD headquarters and circle offices are situated from one to 18 kms away from zonal offices. Insecticides are frequently transported from zonal stores to circle offices through bicycles for utilization.

(v) In 57 *per cent* of circles, proper space was not available for storing

insecticides and petroleum products, while 60 *per cent* of circles had no space for storing used and empty containers.

1.7.3 Non-functional equipment

Chemical control measures of vector management are undertaken with the help of various types of pumps. Audit noted that 26 *per cent* of available pumps/machines were not working in the MCsD while 65 *per cent* of available pumps/machines were not working in NDMC.

In Northern Railway against the requirement of three fogging machines only one fogging machine was available while another was lying out of order. Further, only 10 Knap Sack pumps were available against a requirement of 15 pumps.

1.7.4 Shortage of human resources

The Malaria Department was formed in the early fifties. Though the inhabited area and the population of Delhi has increased manifold since then, the sanctioned posts in Malaria Department has not been reviewed. MCsD were suffering from shortage of supervisory staff ranging from 46 to 97 *per cent* and in workmen cadre from 20 to 36 *per cent*.

In NDMC, there was no sanctioned post of entomologist, while sanctioned posts of epidemiologist and sanitation officer were lying vacant as of January 2016. There was 12 *per cent* shortage of Anti Malaria Gangmen (AMGs) and 47 *per cent* shortage of Anti-Malaria Jamadaars (AMJs). Though there was shortage of field staff, many Malaria Inspectors (MIs), Assistant Malaria Inspectors (AMIs) and Field Workers (FWs) were deployed on ministerial work.

There was a shortage of 22.22 *per cent* of manpower in field worker cadre with the Chief Health Inspector (Northern Railway) and necessary training for vector management was also not provided to the field workers.

Mosquito control is a labour intensive task requiring regular supervision. The current availability of human resources is clearly not commensurate with the extent of the problem and the concerned departments were not in a position to fully and effectively implement IVM in NCT of Delhi.

MCsD stated (May 2016) that matter for filling up vacant posts was being pursued.

1.8 Behaviour Change Communication

1.8.1 Non-formation of multi-disciplinary planning team

As per WHO guidelines, dengue fever epidemiology requires a mixture of

expertise in different disciplines to define the required set of technically sound solutions. This necessitates assembling of a multi-disciplinary planning team. However, the same was not formed by the State Program Officer in Delhi.

1.8.2 Ineffective public awareness campaign

Public awareness campaigns are intended to increase community awareness about dengue related prevention and control measures.

(i) Government of NCT of Delhi

The main period for the spread of dengue viruses (outbreak) is June to November every year and publicity campaigns relating to prevention of dengue was to be released before the spread of dengue viruses i.e. in June and July. During the last three years, GNCTD incurred an expenditure of ₹ 10.04 crore on awareness campaigns for prevention of dengue as shown in **Table 1.1.6.**

Table 1.1.6: Details of expenditure on awareness campaign

Year	Expenditure *(₹ in crore)*	Period of advertisement
2013-14	4.23	31 August to 19 November 2013
2014-15	0.41	25 October to 23 November 2014
2015-16	5.40	September to October 2015

The advertisements were released between September and November in all the three years i.e. after the outbreak of dengue. Thus, the very objective of the expenditure of creating awareness of the measures to prevent outbreak of dengue was defeated.

(ii) Municipal Corporations of Delhi

Field publicity campaigns of MCsD started in the month of October every year. Launching of public awareness campaign after monsoon season has little justification.

1.9 Case Management

1.9.1 Use of non-recommended Rapid Diagnostic Test (RDT)

The National Guidelines for Clinical Management of dengue fever state that Rapid Diagnostic Kits (RDTs) used for detection of dengue are not considered very accurate and tend to show a high rate of false positives compared to standard tests. WHO guidelines also stipulate that these kits should not be used to guide management of dengue/DHF. Reliance on such tests could result in increase in the case fatality ratio. Hence use of RDTs is not recommended. Only ELISA based kits were to be procured instead of RDTs.

Audit observed that 43 RDT kits were purchased by hospitals at a total cost of ₹ 4,15,543 as detailed in **Table 1.1.7**.

Table 1.1.7: Procurement of RDT Kits

Sl.No.	Hospital	No. of kits purchased	Cost (₹)
1.	RML	10	15,500
2.	BMH	2	27,800
3.	GTBH	22	1,94,670
4.	SRHCH	9	1,77,573
	Total	**43**	**4,15,543**

Use or RDT kits does not provide the requisite degree of assurance as to the accuracy of the diagnosis and assessment of the actual number of dengue cases.

1.9.2 Inadequacies in testing in suspected dengue cases

A large number of OPD and IPD patients of dengue fever were treated during the dengue period from August to November 2015. However, blood sample testing ratio in six selected hospitals revealed that only 44 *per cent* dengue fever patients in OPD and IPD of Medicine and Pediatrics Departments were tested for basic blood tests from August to November 2015. Audit could not ascertain as to how patients in IPD received treatment without pathological tests or follow ups as basic pathological test was a pre-requisite for effective management of patients.

1.10 Conclusion

Despite the recurrence of dengue over the years in the NCT of Delhi and the spike in dengue cases as well as mortalities during 2015, the institutional mechanisms and actions taken by the departments as well as the municipal corporations were not commensurate with the magnitude of the problem though funds were not a constraint. There was no set mechanism for reporting outbreaks or responding to outbreaks and surveillance system for early warning of impending disease and assessing severity of outbreak of disease was inadequate. Malaria circles which are the primary units for field operations suffered from an almost debilitating shortage of basic infrastructure and facilities. Stereo-typical implementation of anti-mosquito measures without mapping with actual delivery of service undermined containment of vector borne diseases.

Environmental modification which is a key element in sustainable vector control was not given due emphasis and MCsD and NDMC largely relied on chemical insecticides to control mosquito population. While extensive spraying and fogging operations for control of adult mosquitoes and other chemical measures for control of larvae were undertaken by all the municipal

corporations at an overall cost of ₹ 43.65 crore, the techniques adopted as well as formulations used differed from that recommended in the Program guidelines raising questions as to their effectiveness. There was no monitoring of the effectiveness of the work done by domestic breeding checkers. The MCsD incurred an expenditure of ₹ 109.43 crore on hiring of these breeding checkers. Absence of a policy for chemical use, not conducting susceptibility tests for insecticides, not carrying out any impact study on techniques applied to control mosquito population and adoption of non-prescript method to control mosquito population indicated absence of informed decision making process in MCsD and NDMC.

While the Northern Railway had undertaken systematic fogging and spraying operations in the areas under their jurisdiction, the Delhi Cantonment Board did not maintain any record of anti-dengue operations in areas under its jurisdiction. The Board utilized only 26 *per cent* of the funds available to it for anti-mosquito operations during the period under review.

1.11 Recommendations

Based on the audit findings, it is recommended as follows:

- *Mapping of dengue prone and sensitive areas in NCT of Delhi may be undertaken and plans framed and prioritized and resources allocated on this basis. The Dengue Task Force should meet at regular intervals for this purpose.*
- *Given the multiplicity of agencies dealing with dengue prevention and control in NCT of Delhi, an inter-agency coordination mechanism may be established to address the matter of prevention and control of dengue in a coordinated and coherent manner.*
- *A Standard Operating Procedure may be developed and instituted for epidemiological surveillance along with requisite laboratory facilities for early warning of impending disease and assessing severity of outbreak of disease.*
- *An impact assessment may be undertaken of the fogging and spraying exercises undertaken by the municipal corporations keeping in view the Program Guidelines and those of the NVBDCP to assess their efficacy and for corrective action if required.*
- *The engagement of DBCs/AMGs by municipal corporations should be reviewed so as to ensure that they are commensurate with the task at hand. The period of their engagement should be synchronized to see that they are engaged during the period when they can actually be deployed for the intended task. The work done by them should be monitored and supervised.*

- *The reporting mechanism may be strengthened whereby all concerned units communicate accurate and timely information relating to dengue cases and dengue deaths to the nodal agency and the same is further transmitted to the Directorate of NVBDCP.*
- *Public awareness campaigns should be planned to commence well before the onset of dengue as a preventive measure and not after its occurrence or when it is on the wane.*
- *Basic infrastructure may be ensured in a time-bound manner to the malaria circles to enable them to effectively discharge their functions. Facilities at hospitals to attend to the upsurge of dengue patients should be reviewed before start of the dengue period and gaps in terms of testing facilities addressed.*

The matter was communicated to the Government of Delhi (May 2016 and July 2016) and to the Union Ministries of Health (July 2016), Delhi Cantonment Board (July 2016) and Railways (July 2016). While Delhi Cantonment Board accepted the facts (July 2016), the replies of other agencies were awaited (16 August 2016).