Proceeding of the 1st International Conference on Public Health, Vol. 1, 2015, pp. 6-15

ISSN: 2324 – 6735 online
DOI: 10.17501/ icoph 2015-1102

USE OF "M" TECHNOLOGY IN PUBLIC HEALTH: INVESTIGATION OF OUTBREAK OF HEPATITIS E IN SARASPUR WARD OF AHMEDABAD CITY, GUJARAT, INDIA

Kansara, K[1], Saxena, D[2], Mavalankar, D[3] and Solank, B[4]

[1,2,3] *Indian Institute of Public Health Gandhinagar*
[4]*Medical Officer Health, Ahmedabad Municipal Corporation*

Abstract

Developing countries have documented outbreaks of various infectious diseases including Hepatitis E (HEV). HEV is transmitted through feco-oral route. Ahmedabad is city located in Gujarat state which is in western part of India, it has reported outbreak of HEV in November 2014. We investigated the outbreak based on m-technology with an aim to develop and test technology to assist in disease surveillance, recognize early warning signals and identify Hot Spots of the outbreak. All cases of HEV reported by the system and applying snow ball sampling, 218 cases were investigated. Data was collected in Open Data Kit (ODK) installed in android based application having google interface. Data on signs and symptoms of disease, time of investigation, diagnosis, hospitalization, co-morbidities was gathered. Descriptive analysis revealed secondary attack rate ranged from 12.5% to 75%. Male were affected more in young age groups while it was reverse in later age groups. The outbreak pattern suggested point source single exposure outbreak. Hot spots and clustering of cases were identified by geo visualization to assist in targeted interventions. "m technology" can provide quick quality data and can assist in prediction of further outbreaks. Spatial analysis of hot spots and clustering of cases by m-technology can be a promising tool for monitoring and surveillance of routine data and can assist in investigation of outbreaks.

Keywords: Hepatitis E, m technology, Outbreak investigation and GIS mapping

INTRODUCTION

Although India is in the phase of epidemiological transition in terms of burden of disease, it is still combating with various communicable diseases such as malaria, typhoid and hepatitis, leptospirosis, acute diarrheal disease, and tuberculosis etc.[1] Ministry of Health and Family Welfare, Government of India have implemented various programs which are focused on each of these disease to prevent its further spread among the population, still sudden outbreaks of diseases like malaria, jaundice, dengue, chickengunia remains an unsolved issue and thus, contribute to be the major public health issue.[2]

Disease outbreaks especially water born and mosquito borne diseases are more common in the urban area and to be more precise in urban slums.

Rapid rise in the population and compact infrastructure are factors responsible for poor slum dwellings. It has been a daunting task for the local government to ensure proper water, sanitary facilities and maintaining clean surroundings in slums. Viral hepatitis caused by A and E viruses is the major public health problem in India. Out of six different types of viral hepatitis known (A, B, C, D, E and G), Hepatitis E virus is the agent responsible for the outbreak of the disease in developing countries.[5] During December 1955 – January 1956 Delhi reported the first epidemic of Hepatitis E in India. After that it gradually increased across Indian Subcontinent.[4] Since 1976 there were seven outbreaks of Hepatitis E reported from Ahmedabad City.[5] Virus of Hepatitis E is transmitted by fecooral route often through water or food supply contaminated by feces.[5, 8, 9] The incubation period of the following exposure

Corresponding Author Email: kkansara89@gmail.com

to HEV ranges from three to eight weeks, with a mean of 40 days.[6] In India, Integrated Disease Control Program (IDSP) monitors, reports and tracks specific disease outbreaks. IDSP carry surveillance on paper based survey system, which has weekly online reporting system where they publish weekly reports on their website.[3] Paper based survey system are often time consuming and are also at higher chances of creating human errors while managing data. For the country like India, where population rise is rapid along with the change in other demographical variables, quick surveys need to be performed by minimizing all possible human errors.

Mobile communication has become mainstream. It is the most successful and certainly the most rapidly adopted new technology in the world, more than one of every three people worldwide possesses a mobile phone.[11] The unprecedented reach of mobile and use of innovations on mobile technologies as well as advancements in these innovative application to address health priorities has evolved into a new field of e health, known as m Health.[12]

According to the International Telecommunication Union (ITU), there are now over 5 billion wireless subscribers; over 70% of them reside in low- and middle income countries. Despite this, higher income countries show more m health activity than so lower income countries and still not being used in surveillance, raising public awareness and decision support system.[12]

Developing countries lack adequate surveillance system, they still continue old methods of disease surveillance which are mainly carried out on paper based surveys which lacks real time data updates. Requirement of effective surveillance is inevitably increasing. If some innovative steps are taken to improve the disease surveillance system then, It will also help in increasing government capacity in developing countries like India, to better monitor emerging and seasonal outbreaks in resourceful and active manner than previous methods.[13] A study from Nakuru, Kenya demonstrated that mobile phones were useful in facilitating communication and decision-making. It helps to quicker communication and easier access to information in an emergency. Such use of mobile phones could especially benefit India, where frequently populations have to face epidemics.

Using the emerging trend of m health, disease surveillance of HEV outbreak was carried out in early November 2014, when vernacular print media started reporting of possible outbreak of HEV in Saraspur ward of north zone of the city of Ahmedabad in Gujarat state. Indian Institute of Public Health Gandhinagar in collaboration with local self-government undertook investigation and surveillance of the HEV outbreak along with detail geo-visualization of the outbreak to identify the hotspots GIS map that can be used for prevention of the further out break.

Study Site

Study was carried out in Ahmedabad City, Gujarat, India. Population of the Ahmedabad City is 7.2 million.[16] Ahmedabad city is divided into six zones north zone, south zone, west zone, east zone, central zone and new west zone. About 90% of the population receives drinking water supply from Ahmedabad Municipal Corporation (AMC). Saraspur is located in north zone of the city which covers the area of 1.96 sq kms have 24 chawl clusters in the area.[17] Many of the newly added areas in the city have PVC water pipelines lines. In compact area like north zone distance between water lines and drainage lines are very less. Although AMC has a set mechanism for allotment of new water connections but illegal water connections, electric motoring during and off the water supply, over flowing drains and open nicks with lack of drains are challenges faced by AMC.

Along with the media reporting we also reviewed IDSP 46th week report, which consist Disease surveillance data of second week of November. IDSP reported 80 positive cases of hepatitis E, Cases were reported from nani vasan sheri of Saraspur ward located in north zone of Ahmedabad. District Rapid Response Team (RRT) also visited the affected area. House to house survey was also carried out by IDSP team followed with chlorination of the water of the affected area. After a week of surveillance vernacular newspaper was still reporting higher number of cases of HEV outbreak. Moreover, Ahmedabad Municipal

Corporation also continued reporting new HEV Cases. Thus, looking to this an attempt was made to carry out disease surveillance using mobile application, weekly reporting of surveillance data was the main cause of missing out the new cases which results in slow reporting of the cases.

METHODOLOGY

A formal permission was sought from AMC to provide list of cases recorded by their surveillance system until November 2014. A survey tool was designed using Open Data Kit (ODK) application which was then interfaced with google platform and further transferred to mobile phone which is known as ODK collect application installed in android application. Information was collected using mobile phone with an android system. After collecting all the information, data was gathered and survey results were stored in ODK aggregate. The survey tool consisted the questions based on socio-demographic profile of cases, sign & symptoms, onset, progression of disease, geo mapping the cases and identify hotspots. This tool was pretested before using it at field level. All the data collectors were also trained to use the application before handling the application for surveillance. Snow ball sampling was further used to find all the missed cases.

Data collectors collects information from the individual cases separately in the ODK format and send it to ODK aggregate which is a centralized could-based data base.

Randomly six samples of tap water were also collected from those pols that reported highest number of HEV cases. Further, this data stored in the arggegate cloud based data storage and was exported into a excel sheet in xml file format. Data in xml file format was then exported to SPSS v16, a statistical software, where it was analysed for getting statistical results. (refer to figure 1).

RESULTS

A total of 217 cases were identified from surveillance system of AMC, following permission from them, IIPHG identified 27 more cases of HEV during the period of surveillance. Overall, 243 cases were identified, out of which cases 25 cases were lost to follow up mainly due to migration or because of locked houses or wrong address. However, the survey team could identify 218 cases, which showed confirmed HEV cases.

The Index case of HEV was first documented by IIPHG on 29th November 2015 however the last case documented was on 5th Dec 2014, It apparently shows a classical point source single exposure epidemic, where all the cases were in the range of one incubation. The cases increased and decreased sharply and there was no secondary wave until January 2015. (refer to fig. 2)

There were 130 households with only one case, whereas there were 12 households where there were two cases and 16 households where number of cases were three and there were only 4 households where there were 4 cases who were having disease. Overall there were around 88 households with more than one case in the household. The Secondary Attack Rate ranged from 12.5% to 75%. For technical reasons the SAR were calculated at household level.

Out of total cases 192 (88%) were notified to the AMC during their surveillance while 26 (12%) were newly diagnosed but were not notified in the AMC list. There were around 49% of the cases were male and another 51% of the cases were female.

Cumulatively majority of the cases were below the age of 30 years (66.5%), as per gender distribution 49% were male while rest were female. It was found that the mean age of participants was 28 ± 14.2 years. The mean age of the male participants was 25 ± 13.8 years while the mean age of female participants was 30.8 ± 14.1 years. Out of total males, 26.42 % of the total males were less than 15 years where as amongst females maximum belonged to the age group 16-20 years (18.75%). (refer to table. 1)

As per the residence of the cases, majority of the cases in the present study were from non-slums (84.4%), whereas only 15.14% were from notified slums as per the AMC. All the subjects included in the study were inquired about clinical presence of the symptoms who were infected with HEV. It was found that most of the subjects had abdominal pain (26.51%) on the onset of the disease, while other subjects had combination of two or more signs and symptoms such as Fever and abdominal pain

(31.50%), dark urine and abdominal pain (5.51%) and so on. (refer table 2).

More than half of the cases (55.5%) visited health care facility within the period of one to two days after occurrence of symptom. It was noticed that female were more concern about early diagnosis as percentage of female cases who have visited doctor within the period of one to two days were higher (56.25%) than male (54.72%) cases. About 22.64% were male and 16.07% were female who visited health care facility on the day when symptom appeared. Thus, when data was further analyzed to know the average number of days delayed in diagnosing a disease then it was found that, there was delay of 2days, mean 1.94±1.90 SD. (refer table 3)

Occurrence of the symptoms and visiting health care facility doesn't solve the problem, for accurate diagnosis laboratory tests are mandatory for further confirmation of the disease. Liver function tests was carried out if a doctor suspects HEV to patient with the disease specific signs and symptoms.

In the study population it was found that 68.81% of the cases have undergone laboratory investigations on the same day when they were diagnosed for the disease, out of them percentage of the female (69.64%)

were higher than that of male (67.92) cases. Alertness about the disease was higher among few cases, it may be due to already existing case in the household and suspecting its contagiousness. There were 3.57 % of female and 1.89% of the male who have undergone laboratory investigation before visiting health care facility. There were only 3% of the people who delayed their lab investigation by more than one week. Mean delay in diagnosing a disease in number of days and lab tests investigations were found out to be 0.52±1.39 SD. (refer table 4). Out of 218 total cases found, 66.51% cases were below the age of 30 years and only 33.48% of the cases belong to more than 30 years of age group. There were total 137 out of 218 cases who were not hospitalized after their diagnosis and lab test confirmation. Out of these 137 cases,

17.52% of the cases were below the age of 15 years, 16.06% were within the age group of 21 to 25 years, and 18.98% were of the age group of more than 46 years while rest cases belong to other age groups (refer table 6)

Sixty nine cases out of 218 were hospitalized for a week , where 21.74% of the cases belong to the age group of 26 to 30 years of age followed with 18.84% in the age group below 15 years, 15.94% in the age group between 16 to 20 years, 13.04% belong to the age group of 21 to 25 years while others belong to more than 30 years of age group, but the number of cases were not as higher as number of cases in less than 30 years of age group.

There were about total 12 cases out of 218 who were hospitalized for more than a week, out of them 25% of the cases belong to the age group of less than 15 years, between 16 to 20 years and between 21 to 25 years. There were only 3 cases who were hospitalized for more than a week above the age of 30 Years. (refer table 6) Out of total 218 cases, there were 48.62% male and 51.38% were female, from 137 cases who were not hospitalized 55.07 % were male and 44.93 percentage were female. Cases who were hospitalized for more than a week were 12 where 50 % were male and 50% were female. (refer table 7)

DISCUSSION

Present study documented surveillance of HEV outbreak, which was carried during the period of November to December 2014 in Saraspur block of Ahmedabad City with the use of m based technology. In India disease survaillance is carried out under Integrated Disease Survaillance Program (IDSP) which have weekly reporting system, in their report of 46th week of survaillance it has shown that, there were 80 cases detected with Hepatitis E disease.[18] District RRT team also visited the affected area and also provided symptomatic treatment to all the detected cases, moreover, chlorination of the water was also done.[3] This might be one of the reason for adequate chlorine levels as documented by IIPHG after IDSP surveillance,. Although, the cholrine content of the water can not be the primary preventive measure to control the incidence of the HEV outbreak, hence, despite of the water clorination carried out by RRT team of IDSP, the incidence of the cases still did not stopped.[14] It was observed that the number of cases infected with the

HEV do not have wide difference when compared from 2008 to 2014. In 2008, during the HEV outbreak in urban slum of Girdharnagar Ahmedabad, there were 233 positive cases.[5] In 2012, when Gujarat Cancer Society, carried out the outbreak investigation of HEV in urban slum region, they found 255 positive cases of HEV.[4] But, the cases investigation showed more number of cases in non slum region compare to urban slums

This study also showed a classical point source epidemic, where all the cases were in one incubation period. In the previous studies also, the epidemic of hepatitis E occurs in the unimodal outbreak with a single peak suggestive of single point source, common vehicle epidemic.[5]The incidence of the disease was observed more among the population belonging to the age below 30 years, while the incidence was lower among the population of the age group higher than 30 years. This epidemiological feature is similar to that observed in the previous reports on hepatitis E outbreak , where it was observed that younger population is affected more than the older one.[4-5]

Secondary attack rate amongst the households of population ranged from 12.5% to 75%. Which means that there were around 22% of the household had secondary or tertiary or quaternary cases which were found during the outbreak of the disease. Number of female who were diagnoised with positive HEV were more than the number of male. Previous studies showed lower secondary attack rate than the present one.[4] The most common symptom noticed was fever along with abdominal pain (32%) population. There were few cases who were aware about the symptoms of Hepatitis, before appearance of symptoms they themselves went for laboratory investigation before diagnosing of the disease by the physician.

Such action on individual part clearly shows concern on how the city people who repeatedly experienc the disease outbreaks. Looking on to the technical aspect of collecting disease surveillance data on mobile based application compare to paper based survey, it can be clearly concluded that the m based application can collect data more quickly as it does not involve one major step of data entry of the data. Data once entered in mobile just has to be exported to other applications or softwares in computer after converting the file, which hardly takes few seconds. With the help of mobile based application collected 218 cases in a period of one week while IDSP collected data of only 80 cases. This clearly defines the quick reporting of surveillance data with the use of mobile based application. Follow up of the cases becomes easy and quick. Chances of missing out cases becomes almost negligible. As the process of collecting and analyzing the information from the participatory systems become more refined, along with increasing penetration of sophisticated tools such as cellular phones as used in the systems described here, it can create even greater opportunities to gather more detailed structured data for public health reporting.15 There is a urgent need for nationally representative technology based surveys and getting a better picture of the epidemiological situation of hepatitis in India. Lastly India should also focus on technology based capacity building of its medical staff including nurses and field staff going for disease surveillance, which would be helpful in excuting the program in more effective way, which can help in quick reporting and quick control in the spread of the disease.

RECOMMENDATIONS

This mobile based disease surveillance system can be adopted in collaboration with the IDSP cell. ODK enabled devices can be provided to the field workers going to collect surveillance data. As the system utilizes completely free software, its implementation has the minimal cost and thus it is cost effective. Places where the mobile phone is not in propoer network, data can be kept saved in the mobile phone which can be further trnasferred through USB or it can also be sent later once the mobile phone is under the coverage of the network. In addition to the disease survellance tool this can be use also as disease reporting tool, this system could be used for a disease reporting tool for the health care monitoring.

FIGURES

Figure.1: Process of preparing *a* survey form, collecting data and storage of data

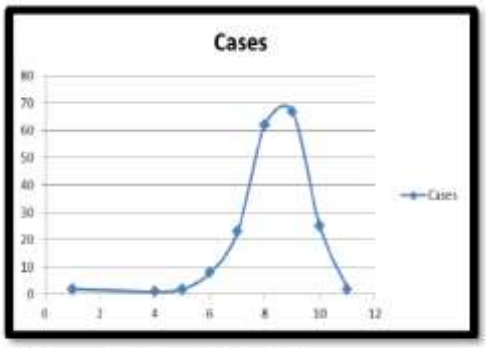

Figure. 2: Epidemiological curve number of cases

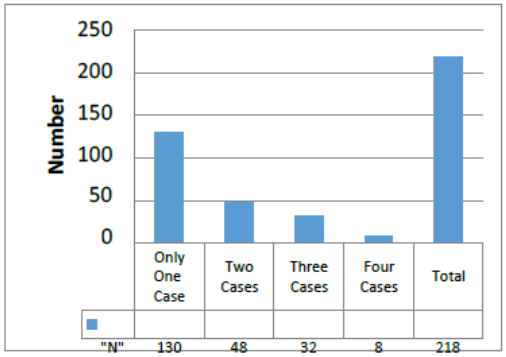

Figure 3: Number of cases per households of

TABLES

Table 1: Distribution of study population as per the Age group and Gender

AGE-GROUP	Gender		Total
	Male (%)	Female (%)	
≤15	28 (26.42)	12 (10.71)	40 (18.35)
16 to 20	17 (16.04)	21 (18.75)	38 (17.43)
21 to 25	22 (20.75)	12 (10.71)	34 (15.60)
26 to 30	16 (15.09)	17 (15.18)	33 (15.14)
31 to 35	3 (2.83)	12 (10.71)	15 (6.88)
36 to 40	6(5.66)	10 (8.93)	16 (7.34)
41 to 45	2(1.89)	9 (8.04)	11 (5.05)
≥46	12 (11.32)	19 (16.96)	13 (5.96)
Total	106 (100)	112 (100)	218 (100)

Table 2: Distribution of Symptoms in the study population

Symptoms	Number	%
Fever + Body Ache + Abdominal Pain	16	4.20
Fever + Abdominal Pain	38	9.97
Fever + Dark Urine	20	5.25
Dark Urine + Abdominal Pain	21	5.51
Dark Urine only	54	14.17
Fever + Abdominal Pain	120	31.50
Abdominal Pain alone	101	26.51
Others	11	2.89
Total	381	100.00

Table 3: Distribution of the study population and their delay in access to health care and laboratory investigation for confirming the disease

Sr. No	Number of days	Male (%)	Female (%)	Total (%)
1	Primordial Access to Health care facility	0 (0)	0 (0)	0 (0)
2	Went to Health care facility on the day of appearance of any symptom	24 (22.64)	18 (16.07)	42 (19.27)
3	Went to Health care facility within 1 to 2 days of symptoms appear	58 (54.72)	63 (56.25)	121 (55.50)
4	Went to Health care facility within 3 to 4 days of symptom appear	12 (11.32)	22 (19.64)	34 (15.60)
5	Went to Health care facility within 5 to 6 days of symptom appear	5 (4.72)	6 (5.36)	11 (5.05)
6	Went to Health care facility with in after a week of symptoms occurrence	7 (6.60)	3 (2.68)	10 (4.59)
	Total	106 (100)	112(100)	218 (100)

Table 4: Distribution of study population and their delay in access to health care facility and onset of symptoms (in days)

Sr. No	Variable	Male (%)	Female (%)	Total (%)
1	Primordial Lab test for Liver function tests even before the onset of any symptoms	2 (1.89)	4 (3.57)	6 (2.75)
2	Lab test for Liver function tests on the same day of suspected clinical diagnosis	72 (67.9)	78(69.6)	150(68.81)
3	Lab test for Liver function tests 1 to 2 days after diagnosis by health care profession	23 (21.7)	23(20.5)	46 (21.10)
4	3 to 4 days after diagnosis by health care profession	6 (5.66)	5 (4.46)	11 (5.05)
5	5 to 6 days after diagnosis by health care profession	2 (1.89)	0 (0.00)	2(0.92)
6	Delayed by more than a week by health care profession	1 (0.94)	2 (1.79)	3(1.38)
Total		106 (100)	112 (100)	218 (100)

Table 5: Distribution of Study Population as per the history of Hospitalization

AGE_GROUP	Not Hospitalized %	< 1 wk (%)	>1wk (%)	Total (%)
≤15	24 (17.52)	13 (18.84)	3(25)	40 (18.35)
16 to 20	24 (17.52)	11 (15.94)	3 (25)	38 (17.43)
21 to 25	22 (16.06)	9 (13.04)*	3 (25)*	34 (15.60)
26 to 30	17 (12.41)	15 (21.74)	1 (8.33)	33 (15.14)
31 to 35	7 (5.11)	8 (11.59)	0 (0)	15 (6.88)
36 to 40	8 (5.84)	7 (10.14)	1 (8.33)	16 (7.34)
41 to 45	9 (6.57)	2 (2.90)	0 (0)	11 (5.05)
≥46	26 (18.98)	4 (5.80)	1 (8.33)	31 (14.22)
Total	137 (100)	69 (100)	12 (100)	218 (100)

**Three individuals were hospitalized at the time of survey*

Table 6: Distribution of study population as per gender and history of hospitalization

Gender	Not Hospitalized **(%)**	< 1 wk (%)	>1wk (%)	Total **(%)**
Male	62 (45.26)	38 (55.07)	6 (50)*	106 (48.62)
Female	75 (54.74)	31 (44.93)	6 (50)*	112 (51.38)
TOTAL	137 (100)	69 (100)	12 (100)	218 (100)

REFERENCES

1. Baridalyne N, Patro BK, Chandrakanta S. P. Current Status of Communicable and Non- communicable Diseases in India. Journal of Association of Physician of India. 2004; 52, 118-123.

2. Mohapatra S and Dar L. Emerging and remerging viral infections in India. Journal of

International Medical Science Academy. 2010; 23, 37-40.

3. Integrated Disease Surveillance Program . 24 April 2015. <http://www.idsp.nic.in/>

4. Dave V, Garsondiya J, Solanki A, Sonaliya K. N. An Outbreak Investigation of Viral Hepatitis E in Urban Slum Area of Ahmedabad City of Gujarat, India. GCSMC Journal of Medical Science. 2012; 1, 12-16.

5. Chauhan T. N, Prajapati P, Trivedi A and Bhagyalaxmi. Epidemic Investigation of the Jaundice Outbreak in Girdharnagar, Ahmedabad, Gujarat, India, 2008. Indian Journal of Community Medicine. 2010; 35, 294-297.

6. Khaskheli M. N, Baloch S, Sheeba A, Baloch S. Hepatitis E- A preventable health issue- endangering pregnant women's life and foetal outcomes. Journal of Pakistan Medical Association. 2015; 6, 655-659.

7. Arankalle A. V. Hepatitis E in India. National Academy of Sciences, India Section B: Biological Sciences. 2012; 82, 43-53.

8. Tandon B.N, Gandhi B M, Joshi Y K, Irshad M, Gupta H. Hepatitis non A, non-B: The cause of major public health problem in India. Bull World Health Organ. 1985; 63, 931-934.

9. WHO Hepatitis E, Chad Wkly Epidemiol Rec. 2004; 35, 313-320

10. DeSouza, I. S., Rashmi,, R. M., Vasanthi, P. A., Joseph, M. S., & Rodrigues, R. Mobile

Phones: The Next Step towards Healthcare Delivery in Rural India? PLoS ONE, 2014; 9(8).

11 Katz , J. E. Handbook of Mobile Communication Studies. The MIT Press.2008.

12. World Health Organization. mhealth new horizons for health through mobile technologies. Geneva: WHO 2011.

13. Hughes C., Naik S. V., Senugupta R, Saxena D. Geovisualization for cluster detection of Hepatitis A and E outbreaks in Ahmedabad, Gujarat, India 2014.

14. Alain B. L., David L.T., Sonai K S., Kenrad E N., Hepatitis E: An Emerging Infectious

Disease: The John Hopkins University School of Hygiene and Public Health, Epidemiol 1999; Rev Vol. 21 No. 2

15. Freiffeild CC, Chunara R, Mekaru SR, Chan EH, Kass-Hout T, Ayala laccuci A and Brownstein S. J. Participatory Epidemiology: Use of Mobile Phones for Community-Based Health Reporting. 2010.

16. Census 2011.

http://www.censusindia.gov.in./2011census/population_enumeration.html.2015.

17. Ahmedabad Municipal Corporation, http://ahmedabadcity.gov.in/portal/jsp/Static_pages/amc_zone