The chunampet community health information management system: A health and demographic surveillance system from a rural South India

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Abstract:

BACKGROUND: Developed countries have strong health and demographic surveillance system (HDSS), whereas there is a dearth of such system in developing countries like India. India depends on national surveys and individual studies for public health information. At present All India Institute of Medical Sciences – New Delhi HDSS and Vadu HDSS are well established HDSS in India.

MATERIALS AND METHODS: We developed a HDSS in a remote rural area of South India and named as Community Health Information Management System (CHIMS) This covered 20 villages around Rural Health Training Centre – Chunampet. We collected the family and demographic information from March 2018 to October 2018. Pregnancy, birth, under-five and mortality data were collected once in every 3 months with the help of interns, Medical Social Workers. Data collection done using CHIMS Guide and entered in EpiData software. EpiAnalysis, Quantum Geographic Information System, Dropbox were the other freely available software used in this program.

RESULTS: CHIMS HDSS covered 14924 individuals belonging to 4486 households in the surrounding twenty villages. Population density was 213/km^2. CHIMS consumed very limited resources in terms of workforce, materials, and transport. CHIMS database was used as a baseline database for many other studies. This CHIMS HDSS helped in many publications, postgraduate thesis dissertations and mainly attracted many extramural research funds from leading government Research Institutes from India.

CONCLUSION: CHIMS proved to be a robust surveillance system in providing vital public health information about the community and attracted more extramural funds to the institute.

Keywords:

Health and Demographic Surveillance System, Health Information Management System, Health Management Information System, India

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Introduction

What was the need for health and demographic surveillance system set up?

Utility of electronic health information system has increased in the recent years. Electronic system is used in most of the tertiary health-care centers all over

the world.[1-9] Studies from developed countries demonstrated the use of health information system in the primary care setting for providing medical care and linkage to other secondary and tertiary facilities.[1-9] In general, developed nations have a robust Health Information and Surveillance system. However, a country like India does not have such a base, without which public health is getting suffered due

to lack of vital data. However, these electronic data demographic surveillance system and mapping is getting attention in India in recent times.[10-12] At present in India major source of health information comes from Census Survey, National Family Health Survey (NFHS), Civil Registration System, District Level House Hold Surveys and Sample Registration System data.[13,14] Apart from this some premier institutes like All India Institute of Medical Sciences – New Delhi (AIIMS) implemented a community based Health and Demographic Surveillance System (HDSS-Ballabgarh) covering ~90,000 population.[15] Similarly "Vadu HDSS-Pune" is another impressive HDSS from India covering ~160,000 population.[16] These sites contribute a lot to the Public Health policy makers by providing vital information on rural health and also helped their institutes to attract more extramural research funds. Unfortunately for a country with 1.38 billion populations, only very few such sites are available and we aimed to setup such a site in South India, to demonstrate the feasibility of HDSS in Rural India and we named this as Community Health Information Management System (CHIMS).

Where this community health information management system has been constructed?

Pondicherry Institute of Medical Sciences (PIMS) has established a Rural Health Training Centre in a remote village called Chunampet (12°16'20.5"N 79°53'58.7"E) located in Chengulpet District of Tamil Nadu, India, as per Medical Council of India (MCI) norms. Initially, by looking at the poor health status of this vulnerable community and their very limited access even to a basic primary health care, an Australian Nun (Sister Mary Theodore) has established a rural hospital in this village to serve this community in 2001. Later on, in 2002 this center was taken over by PIMS and continuing the service till date with the motto of "Reaching the Unreached." This center spreads across 5 acres of land with a hospital, Community Training Hall, Separate residential quarters for Medical Officers, Interns and Staff. This centre serves as one of the important satellite centers for training medical students and interns as per MCI directions. The main purpose of this center is to deliver a comprehensive health care at an affordable cost to all the rural population surrounding the Rural Health Training Centre (RHTC). Apart from 24 × 7 medical services in the hospital, the center's main area of interest is actively providing medical services to the adjoining villages to meet their health needs.

Evolution of community health information management system

Even though demographic details were collected from 2002 onward and maintained as a hard copies, in 2015 there was a plan to switch over from hard copies to electronic documentation. Inception was based on the experience from Ballabgarh Model.[15] Electronic recording of these details were started in 2015 and initially entered in excel. However, the quality of the data was suffered by entering in excel, apart from this, on follow-up visits it was found to be difficult to identify the households because of poor mapping. At the mean time faculty members from PIMS were received training from "International Union Against Tuberculosis and Lung Disease" (The Union) on efficient data capturing through a free platform called "EpiData," as well as Epicollect and QGIS mapping in subsequent months through structured operational research and training course initiative.[17-19] These are all freely available software on the online platform. Based on these trainings, CHIMS was designed to overcome the challenges which we faced in data collection and mapping of the households previously.

How community health information management system was constructed?

Before starting the data collection planning of the project was done. Questionnaire were prepared and pretested in a subset of population.

CHIMS was constructed with the following five vital steps.

Step 1 – Identification of village: Villages were identified and included one by one in to CHIMS. Ethical issues were discussed with village leaders and proper permissions and liaisons were made. This made our survey easier and robust.

Step 2 – Mapping of the village: Another important challenge in villages was that, there won't be any permanent house numbers. Usually there is no proper planning of the location of houses.[20] To overcome this challenge, we adapted two methods. One is mapping and another is generating Unique Identification number (UID). Mapping of the villages was the most important step in our survey. We studied Google maps of the villages and delineated the borders of the villages and roughly assessed the areas and the number of houses to be covered. Then a transect walk was conducted and a rough mapping without house numbers were prepared. After this, we started collecting data starting from one end of each village and covered all the households. Every house surveyed was given a house number by the investigator and was marked in the map and UID was generated.

Step 3 – Assigning UID: This is the second most important step, where an 11 digit Unique ID was given to all the household members in a structured way. First number in that UID was representing center ID, next two were representing village ID, and the next four were representing house number, and the next two

were representing family number and last two were representing individual number. For example, assume that, if we are surveying the second village and at 30th house and interviewing the first person, then we assign the UID for that individual as 10200300101. This means, this individual belong to 1-RHTC, 02-second village (Village X), 0030–30th house in the village as per the map (which could be easily traced back from the map we created), 01-first family (this number is assigned considering that in a house there may be more than one family also), 01-first person of the family. If that family has 3 persons then second person will be given the UID of 102003000102 and the third person will be given the UID number of 102003000103. While generating UID, we decided to keep the numbers and avoided strings and hyphens, so that the "system sorting" at the time of analysis will be easy. We can also easily trace back any individual in any village if we have their UID. In all our subsequent studies, collection of UID was kept mandatory so that the individual could be easily traced back for any intervention or follow-up study. Recent addition in this mapping was using EPI-Collect software through Smart phones and capturing the Global Positioning System (GPS) coordinates of all the houses and linking with UID and individual records. Mapping and Assigning UID were the heart of the HDSS data collection.

Step 4 – Data collection-In two ways we have collected the data. First is complete survey which is carried out once in a year and second is visiting individual households once in 3 months for capturing of "Vital statistics" (Maternal and Child health [MCH] and Mortality data) [Table 1]. For complete survey, a pretested questionnaire was used and the variables shown in Table 1. One questionnaire was used for each family. Data collection was done based on the data collection guide (CHIMS Guide), which contains details on how to collect data, data variables and their definitions. Data on "vital statistics" (Pregnancy/Births/Under-five/Mortality data) were collected once in every 3 months follow up visits and recorded respective

registers (pregnancy and birth register, under five register and mortality register) Vital Statistics were cross checked with the village women and child development center (Anganwadi) and primary health center.

Step 5 – Data management: Family Data were collected from adjoining twenty villages [Figure 1], from March 2018 to October 2018. MCH/Mortality data were collected and updated in every 3 months. *Quality check* – Quality of the data was randomly checked in four ways, one is by the faculty in-charge and the Medical Officers by frequent field visits and ensuring proper data collection. Second, the data are shared with all concerned in real time in Dropbox App.[21] Where all concerned had a continuous monitoring and supervision on the data. Third Epi Data have an inbuilt "data entry check" options which could be decided by investigators, which prevented the anomalous data entry. Fourth, when there is a conflict in data, the houses were revisited to recheck and correct the data. All the data collected were approved by faculty supervisor after quality check and data entry was
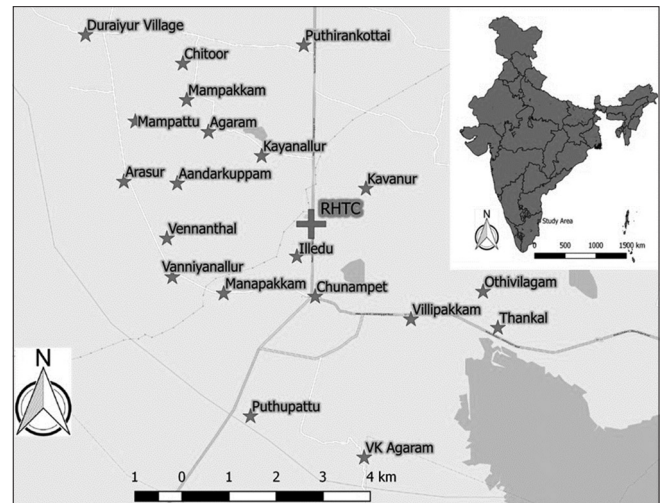

Figure 1: Quantum Geographic Information System mapping of Community Health Information Management System Implementation Site, Chunampet, South India

Table 1: Variables collected during the Community Health Information Management System survey Chunampet, South India in 2018

Levels	Variables
Sociodemographic and morbidity survey done in once in a year	
Sociodemographic - family level	House number, family number, GPS coordinates, drinking water source, purification method, toilet facility, cooking fuel, solid waste disposal, liquid waste disposal, type of house
Individual level	Name, relationship, date of birth, gender, phone, religion, caste, income, education occupation, marital status, smoking, tobacco chewer, alcoholic, hypertension, diabetes, other morbidities, diet, weight, height, systolic BP, diastolic BP
Vital statistics survey done in every quarter of the year	
Pregnancy and birth	Name, LMP, EDD, high risk, total visits during pregnancy, days consumed iron tablets, Gravida, para, abortion, livebirths, place of delivery, date of delivery, mode, outcome, child name
Under five child	Name, date of birth, birth weight, Anganwadi registration details, height, weight, availability of immunization card, Status of immunization, place of immunization, chronic illness, congenital anomaly
Death	Date of death, name, age, sex, cause of death

done in EpiData version 3.1 (Epidata Association, Odense M, Denmark). "Family/Demographic data" were entered concurrently after quality check and "MCH and Mortality data" were entered in January 2019.[22] Files are password protected. Data were backed up in e-mail once in every weeks apart from keeping in dropbox.

Who are all involved in community health information management system?

Two male Medical Social Workers (MSWs) and one female Auxiliary Nursing Midwife (ANM), medical interns were involved in primary data collection and Medical officers and faculty from Community Medicine were involved in supervision of this program. At a time eight to ten interns are posted in RHTC for residential posting. Among them, in a day, two, or three interns were deputed for field service. Data entry was done by interns, MSWs and ANMs under the supervision of Medical Officers and Faculty. As the interns change over every month, 1st day orientation and training on "capturing the data and data entry" was given to all the interns based on CHIMS Guide. One Ambulance with a seating capacity of eight members was used every day under routine rural community health service program. This project is entirely supported by the Institute. One computer and a room of 10 m^2 was used. No special fund allocated for the project.

Which tools used in community health information management system?

Epidata

EpiData version 3.1 was used for data entry and version 2.2.2.182 was used for analysis (EpiData Association, Odense M, Denmark).[22] Epidata is a freely available software which can store large volumes of data occupying limited space. Data entry checks and Entry forms could be easily designed by the investigators. Another advantage is, data from Epidata could easily be transferred to SPSS (SPSS Inc, Chicago, USA) and STATA (Stata Corp. Texas, USA) files without any alteration in "value labels."[17-19] Epi-Analysis was used to analyze the data concurrently at the time of data entry. Advantages of Epi-Analysis is, this won't disturb the data entry and don't allow data manipulation, manually and analyses as external, by this we could have a constant check on the quality of the data. This Epi-Analysis also doesn't need installation and comes with the free package of Epidata.

Epicollect

This is another free online platform by which data collection can be done using Android based smart phones after installing epicollect app V5.[23] GPS coordinates are automatically captured by this app while data collection in the respective households.

Quantum geographic information system mapping

Mapping of the villages was done using Quantum Geographic Information System (QGIS, QGIS Developing Team, Multi Country Group) Software, Version 2.18.16 [Figure 1].[24] This is a free software available online and the training was given by "The Union." In our study, GIS mapping of the area was done. Ethical committee clearance was obtained from Institute Research Board to disseminate the data (Ethical Code number-RC 100/18).

Dropbox V 95.4.441

This is another free online platform for data sharing in real time with multiple users and with multiple systems.[21] The enabled us to continuously monitor the data entry. Final analysis were done in SPSS and STATA.[25,26]

Results

We covered 14,924 individuals belonging to 4486 households in the surround contiguous twenty villages which are spread in an area of around 70 km^2 and thus the population density in our area was 213/km^2. Results of key indicators and key variables are depicted in Table 2. Population pyramid is shown in the Figure 2.

Discussion on Key Indicators and Variables

Many of the results obtained in our analysis are in concordance with the indicators of rural area of Tamil Nadu State (NFHS4 Data).[13] In our study, sex ratio at birth is 951, which is higher than the rural sex ratio (939) of Tamil Nadu.[13] As ours is remote rural area, population is thin having 213/km^2 when compared to state's population density (555/km^2), whereas the national population density is (382/km^2).[27] In our area crude birth rate is half (11/1000 per thousand population) of
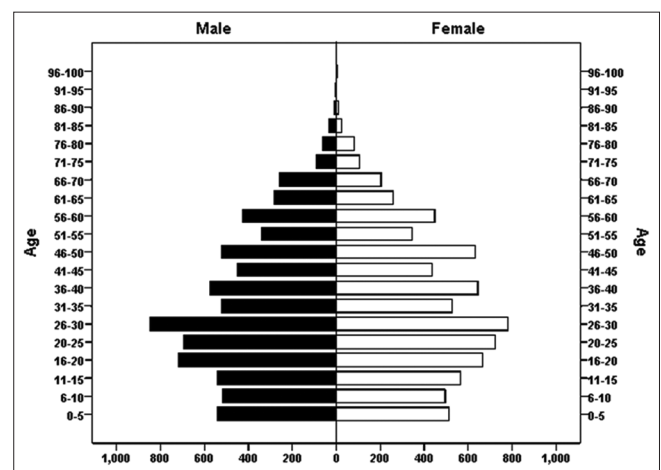

Figure 2: Population pyramid of Chunampet Community Health Information Management System from Chunampet, South India in 2018

Table 2: Demographic characteristics of Community Health Information Management System from Chunampet, South India in 2018 compared to Government data

Key indicators	CHIMS
Mid year population	14,924
Households - Mid year count	3998
Average members per household	3.7
Sex ratio at birth<1 year	943
Sex ration at birth<6 years	951
Population density per sq km	213
Crude birth rate	11/1000
Crude death rate	5/1000
Individual level key variables (*n*=14,924)	***n* (%)**
Age	
0-15	3172 (21)
16-30	4441 (30)
31-45	3155 (21)
46 and above	4156 (28)
Gender	
Male	7444 (50)
Female	7480 (50)
Caste	
Backward caste	1964 (13)
Most backward caste	6260 (42)
Scheduled caste	6660 (45)
Scheduled tribes	17 (0.1)
Other castes	23 (0.2)
Education	
Literate - both gender	9638 (71)
Literate - male	5565 (76)
Literate - female	4473 (65)
Not applicable$	1265 (NA)
Marital status	
Married	7964 (54)
Never married	6002 (40)
Widow-'er'/separated	958 (6)
Current tobacco user*	739 (5)
Current smoker*	423 (3)
Current tobacco chewer*	369 (3)
Current alcoholics*	1005 (7)
Hypertension†	380 (3)
Diabetes†	346 (2)
Family level variables (*n*=3998)	***n* (%)**
Family members	
1-3	1503 (38)
4-6	2260 (56)
>6	235 (6)
Water source	
House connection	1295 (33)
Public pipe	1991 (49)
Tube well	248 (6)
Unprotected dug well	276 (7)
Others	188 (5)
Purification of water	
Boiling	484 (12)

Contd...

Table 2: Contd...

Family level variables (*n*=3998)	*n* (%)
Other methods#	133 (3)
No purification	3381 (85)
Having toilet facility	1367 (34)
Main cooking fuel	
Gas (LPG)	3327 (83)
Induction Stove	6 (0.2)
Kerosene	80 (2)
Charcoal	37 (1)
Wood	548 (13.8)
Solid waste disposal	
Dumped open ground	2840 (71)
Burned in open space	905 (23)
House to house collection	253 (6)
Liquid waste disposal	
Open ground	2971 (74)
Let to the garden	939 (24)
Open drainage	88 (2)
Type of house	
Kutcha	1047 (26)
Pucca	1613 (40)
Semi-Pucca	1338 (34)

$Age<7 years, *Age - 15 and above, †Age 20 and above, #Reverse osmosis, filtration, chlorination. NA=Not applicable, CHIMS=Community Health Information Management System, LPG=Liquefied petroleum gas

National birth rate (22/1000 population), but whereas for Tamilnadu it is 15/1000 population.[14] Similarly, death rate is also slightly lower (5/1000 population) than the death rate of Tamil Nadu (6.7/1000 population) and India (6.9/1000 population).[14] The age-wise distribution of population according to age pyramid shows that the percentage of individuals <16 years of age is lower (21%) than the state's average (24%).[13] Literacy rate among males is 76% and among females is 65% which is lower than the literacy rate (among both males and females) of the whole state (86% and 73%, respectively).[13]

Tobacco users, alcoholics, hypertension, and diabetes cases in our data were lesser than any other national study, as it is based on self-reporting.[28-30] These values cannot be considered as prevalence but these data helped us to target these self-reported individuals for further interventions. Prevalence studies planned in near future. Family level data: most the families (56%) were having 4–6 members with the average 3.7 per family. Most of the families had access to protected water supply (93%), which is same as state average figure. This is because of the recent commitment of government program to provide safe water for all.[31] Only one-third (34%) is still having toilet facility and rest of them still prefer open defecation, which is same as the government survey (NFHS4).[31] Most of the households has access to clean cooking fuel (83%) which was much higher than the state average (58%). Solid waste disposal was very poor at the time of survey (94%-dumped in open

ground), government program on house to house collection of solid wastes through "Swatch Bharath Mission" is implemented in recent days.[31] Only 40% had Pucca (concrete houses) and most of the liquid waste was let out in the open ground (74%). Recent government programs to provide affordable houses for all in villages has improved a lot in the recent past.[32]

Publications, research projects and collaboration from community health information management system

Various publications have been made by extracting baseline data from CHIMS. First was a qualitative study on health seeking behavior of women during pregnancy.[33] Second was a qualitative study on perception of hypertensive patients about their illness.[34] Third was on status of coverage of MR vaccination in the rural areas.[35] Fourth was on level of insufficient physical activity among adults, fifth one was on cardiovascular disease risk among high risk adults and the sixth one was on oral cancer awareness among rural population.[36-38] All these studies used CHIMS-2018 or previously collected HDSS as baseline data for sampling (sample frame), to identify the target study population.

Apart from these at present two extramural funded multi-centric projects are ongoing, one is Indian Council of Medical Research–Centre of Advanced Research Excellence for kidney disease project 2018–2024 (Ref No RC 18/105), in which hypertensive and diabetes patients were extracted from CHIMS for enrollment in the project. This project is aimed to establish the relationship between a novel mRNA marker and Chronic Kidney disease and use this as an early prediction marker. Another is a National Biopharma Mission (NBM) Biotechnology Industry Research Assistance Council (BIRAC) (BIRAC-DBT-RFP3 Project 2020–2023 (Ref No: BT/NBM/0208/05/19), which is aimed to conduct a Community Based Dengue surveillance in this remote rural area. This project is using CHIMS as the base for building surveillance population. Apart from these, CHIMS is serving as a basis for four MD thesis dissertations (Health Problems of Peri-Menopausal Women, Menstrual Hygiene, Contraceptives Prevalence, Diabetic Retinopathy Prevalence using Portable fundus Photography).

Strengths and weaknesses of community health information management system
Strengths
Our study has following four strengths, first generating demographic profile and health related indicators which helped in better functioning of rural health training center and planning of further intervention programs in the community. Second, there is a dearth of such HDSS sites in India and ours will be the third site publishing its

HDSS next to AIIMS-Delhi and Vadu HDSS.[15,16] Third, maintenance of the demographic as well as information related to the vital statistics of the community using online platform coupled by GIS, has made the whole function of the system more transparent and this has leads to many extramural funded research projects. Last, this is the latest HDSS where available free software programs were used and thus this demonstrated a feasible model to replicate in any other similar rural settings having limited resources.

Limitations of our study are, first comparison of the data with that of the previous years was not possible as they were not recorded electronically. Furthermore, QGIS coordinates were collected for only few households. Third, CHIMS data are covering a population of ~ 15,000 which is not an adequate population for mortality statistics. Fourth, "double data entry" couldn't be done due to high volume of data as it was the maiden effort of the institute. Double data are a way of quality check where data entered two times and compared using EpiData. This will be implemented in due course and subsequent surveys. fifth we couldn't able to have a quality cheque of 10% of the data due to workforce deficiency in the first visit, but the data will be checked and updated every year.

Comparison of community health information management system with other available health and demographic surveillance system from India
At present in India two centers has published their HDSS.[15,16] "Ballabagarh HDSS" is a very comprehensive HDSS system covering ~ 90,000 with frequent visits. Because of its complex nature, this model seems to be difficult in implementing in our setting. Whereas "Vadu HDSS" has a very simple yet impressive data base covering ~ 160,000 populations collecting key variables and important indicators in the initial round and then building the data base with supportive researches and cohorts. CHIMS is similar to "Vadu HDSS" in terms of methodology. The main novelty in CHIMS is, it made use of available free software and electronic system and the notable weakness is it covers less population (~15,000) with more key variables than "Vadu HDSS."[16] After the success of CHIMS first phase, it has been planned to expand the base population from 15,000 to 100,000. To achieve this, variables may be reduced and only vital information will be collected in future. Collection of individual household GPS coordinates will be expanded to all the villages. Double data entry will be carried out in the next survey.

Conclusion

CHIMS–HDSS is demonstrated to be an effective and feasible public health surveillance system from a remote rural area of south India. This helped in many research publications and

attracted many extramural funded projects. This also served as a base for many projects, students thesis and helped in providing vital statistics to the public health.

Supplementary data

CHIMS-Epidata codebook, CHIMS Guidebook, Data collection pro forma, Epidata installation files, and Epidata tutorial links will be shared free of cost with the interested researchers by the corresponding author, if requested by mail. Further details are available in our Institute official website (http://www.pimsmmm.com/Healthcenters.htm).

Conflicts of interest

There are no conflicts of interest.

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