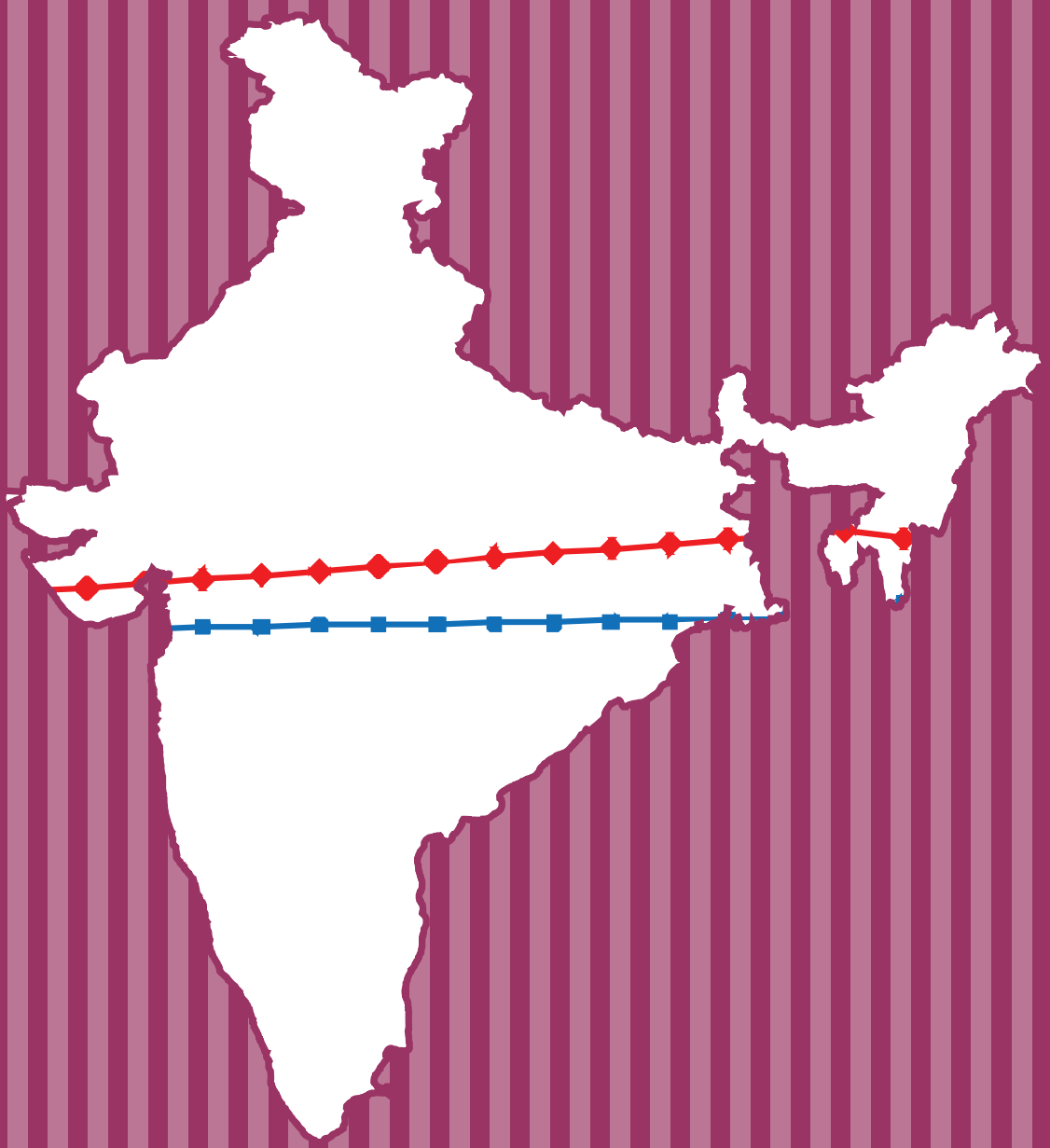
NATIONAL CANCER REGISTRY PROGRAMME

Cancer in Bhopal: Comparison of Cancer Patterns in MIC Affected and Un-Affected Areas (1988-2007)



Indian Council of Medical Research

NATIONAL CANCER REGISTRY PROGRAMME

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Cancer in Bhopal: Comparison of Cancer Patterns in MIC Affected and Unaffected Areas (1988-2007)

Prepared by

The Coordinating Unit
National Cancer Registry Programme, Bangalore

in Collaboration with

Population Based Cancer Registry
Gandhi Medical College, Bhopal

Bangalore
November 2010

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Staff of Coordinating Unit, NCRP, Bangalore.

FOREWORD

I am happy to write this foreword for the report on "Cancer in Bhopal: Comparison of Cancer Patterns in MIC Affected and Unaffected Areas". Soon after the tragic leakage of methyl isocyanate gas in Bhopal in 1984 the Indian Council of Medical Research commenced the Population Based Cancer Registry (PBCR) of Bhopal under ICMR's National Cancer Registry Programme (NCRP).

This report of twenty years of data from 1988 to 2007 compares the magnitude and patterns of cancer between the MIC affected and unaffected areas of Bhopal. Over the years, the registry has seen changes in the Principal Investigators but the core staff responsible for data collection has remained the same. Further, data collection, checking, analysis etc. has been continuously monitored and coordinated by the NCRP of the ICMR. The Bhopal cancer registry data has been periodically published over the years as part of the PBCR reports under the NCRP.

The data presented here provides a valuable scientific document on the comparative incidence of cancer and its trends over time in the MIC affected and unaffected areas. It is important to note that a higher incidence of tobacco related cancers has been observed in MIC affected areas as compared to MIC unaffected areas. However, that significance was lost when the tobacco habits in the populations of the two areas were taken into account.

I am aware that the Coordinating Unit of NCRP located at Bangalore has laid special emphasis on quality of the data exercising internationally accepted norms. I am sure the readers will appreciate the quality of report. Support provided by the heads and staff of the PBCR and that of the contributing institutions also deserves mention. I hope that the report will stimulate in-depth investigations on various aspects of prevalent cancer in Bhopal so that the benefit of research reaches the people of Bhopal.

Dr V. M. Katoch
Secretary, Department of Health Research &
Director General, ICMR

PREFACE

On the night of 3rd December 1984, a chemical disaster occurred in Bhopal, the capital city of the state of Madhya Pradesh. A toxic gas, identified as Methyl Isocyanate, suddenly escaped in a gaseous form from the plant of Union Carbide, affecting a vast majority of the population of Bhopal. According to ICMR estimates, over sixty percent of the population suffered due to inhalation of the toxic fumes and approximately 2000 persons died within 72 hours of their exposure to the gas. A large number of survivors suffered acute multisystem morbidities – eyes and lung being the main target organs. Soon after the gas tragedy, based on the number of deaths in various localities, the municipal wards of the city were broadly divided into MIC affected and MIC unaffected areas.

Following the catastrophe, the Indian Council of Medical Research initiated many studies among the gas exposed population to evaluate the ill effects of the toxic gas. One of these was a Population Based Cancer Registry (PBCR) that was set up in the Department of Pathology, Gandhi Medical College, Bhopal. This was a special purpose registry to observe the effect of the gas in the occurrence of cancer in the affected and unaffected areas. The registry started working from 1st January 1986, registering all cancer cases of residents of Bhopal.

A number of research staff appointed under the Bhopal PBCR has made valuable contribution towards the collection of data. The Coordinating Unit of the National Cancer Registry Programme at Bangalore has played an important role in standardization of protocol, development of appropriate tools for collection, processing, analysis and interpretation of the data. Such painstaking efforts have culminated in this document on "Cancer in Bhopal: Comparison of Cancer Patterns in MIC affected and unaffected areas".

The report has undergone considerable discussions at various expert committee meetings (both of the NCRP and that constituted specifically for the various studies on Bhopal MIC exposure), before the same was finalized and approved for printing. I am grateful for the efforts and inputs of all the experts and congratulate the Coordinating Unit of NCRP and the Bhopal PBCR in bringing out this scientific report.

Dr Bela Shah
Head, Division of Non-Communicable Diseases, ICMR

Cancer in Bhopal: Comparison of Cancer Patterns in MIC Affected and Unaffected Areas (1988-2007)

Executive Summary

Bhopal is the capital of the state of Madhya Pradesh in central India. A chemical disaster caused by the leakage of toxic gases from the factory of Union Carbide in Bhopal on the night of 3rd December 1984 led to massive mortality and morbidity in the city. Methyl isocyanate (MIC) was identified as the major ingredient of the toxic gas, which caused the catastrophe.

Soon after this tragedy, that received world-wide attention, the Indian Council of Medical Research (ICMR) initiated many studies to evaluate the ill effects of the toxic gas in the exposed population. One such study was the setting up of a Population Based Cancer Registry (PBCR) under the National Cancer Registry Programme of the ICMR.

McLennan has defined cancer registration as a process of continuing systematic collection of data on the occurrence and characteristics of reportable neoplasms *(McLennan et al, 1978)*. Broadly there are two types of cancer registries – the Population Based and the Hospital Based. Registries could also be developed for a special purpose in relation to specific exposures, or, they could also be established for a specific anatomical site like Bone Tumour and Lymphoma registries. The Bhopal PBCR is an example of a special purpose PBCR.

The basic thrust of a PBCR is cancer in the community. PBCRs provide information on cancer incidence and mortality in a defined population, for a specific period of time. They also provide information on variation in incidence or mortality over time and with follow up, population based cancer survival rates. To initiate, establish and sustain population based cancer registries as per international norms requires meticulous planning, cooperation of medical institutions in the area, dedicated and committed personnel and adequate funding.

Cancer is not as yet a reportable disease in India. Therefore, methodology of data collection by the PBCRs is active, in that, staff of registry visit various sources of registration to collect information on cancers recorded in those institutions. Within a source of registration, there are several places for gathering information on cancer cases. These include pathology reports, medical records, radiology and radiotherapy departments and death certificates. The availability of up-dated investigation / diagnostic facilities in the registry area, well maintained medical records using International Classification of Diseases, together with an efficient death registration system are essential for completeness as well as good quality cancer registration. The advent of computing technology is gradually changing the method of working of cancer registries in India.

The Bhopal PBCR started working from 1st January 1986, registering all cancer cases with a diagnosis from that date and who were residing in Bhopal for at least one year prior to the date of diagnosis. The main objectives of the registry were to know the magnitude and patterns of cancer in Bhopal as a whole

and also observe whether any differences in the incidence rates or patterns over time were seen in the gas exposed population compared to those who were not exposed.

Registration of cancer cases started initially with fifty four sources which have now increased to sixty three sources of registration. The sources include diagnostic centres and hospitals that provide cancer directed treatment. The social investigators visit these sources to collect information in a prescribed format. Whenever possible, the information on cases is collected by interviewing the patients/relatives at the source, otherwise the details are noted down from the medical records/case files. The data submitted by the registry is subjected to various types of quality checks, which include duplicate checks and other consistency checks such as related to age, sex, site of cancer and morphology. One of the key items of information that was and is specifically collected by the Bhopal PBCR refers to whether the cancer patient's permanent place of residence is located in the area classified as "MIC affected" or "MIC unaffected".

Cancer incidence rate is generally expressed as age adjusted or age standardized (according to world standard population) incidence rates (AAR) per 100,000 persons. In order to derive such figures, the total as well as five year age group numbers of population for each year are required. Besides, the same data is required for both "MIC affected" and "MIC unaffected" areas. The Census of India (Census of India, 1981, 1991, 2001) population figures available for the years 1981, 1991 and 2001 were used. The Difference Distribution Method *(Takiar and Shobana, 2009)* was used to calculate the five year age group population estimates during the inter-census years for the two areas.

Chapter 1 introduces the reader to Bhopal and the events that led to the commencement of the cancer registry under the framework of the NCRP of the ICMR.

The Material and Methods that were used to derive the results are given in Chapter 2 with elaboration of the same in Chapters 5 and 6. This includes estimation of the population using the Difference Distribution Method.

Comparison of the cancer incidence rates in the MIC affected and unaffected areas are described in Chapter 3. For all anatomical sites of cancer in both males and females the overall AAR was higher in the affected area. In males, cancers of certain anatomical sites associated with the use of tobacco showed a higher incidence rate in the affected area compared to the unaffected area. Thus cancers of the tongue, mouth, hypopharynx, oesophagus and lung showed a higher incidence in the affected area compared to the MIC unaffected area. However, when the tobacco habits of the populations in the two areas were taken into account (Chapter 3) the higher rate observed in the MIC affected area was essentially neutralized. This suggests that the higher AAR observed in the MIC affected area was due to the higher proportion of the population consuming tobacco rather than due to the effect of the MIC exposure per se. Among females a higher incidence of cancer of the cervix was observed in the affected area and a higher incidence of cancer of the breast was seen in the unaffected area. Cancer of the cervix is known to have a higher incidence rate in the lower socioeconomic strata of society *(Teppo L, 1984)* and this is vice versa for cancer of the breast. Our surmise is, that, majority of the population of the affected area are from a lower socioeconomic group compared to the unaffected area, though we do not have hard data to substantiate the same.

Chapter 4 gives a description of the trends in AARs over the twenty year period in the two areas. Cancers of all sites in both males and females and in both affected and unaffected areas showed overall a statistically significant increasing trend in the AARs over the years – 1988 to 2007. This is in keeping with what is observed in other PBCRs (NCRP, 2009) under the NCRP. Among the specific anatomic sites, cancer of the lung in males showed a significant increase during the first eleven years (1988-1999) and thereafter a decline in the affected area only. There was no significant change in the AAR of lung cancer (in males) in the unaffected area. Among females, cancer of the breast showed a significant increase in AARs in both the areas and this is in tune with that observed in other urban PBCRs in India (NCRP, 2009).

The authenticity of the data depends on its quality, and with reference to the PBCRs, this would be both in terms of completeness of coverage of cancer cases in the geographic area as well as the reliability of the data. Registries routinely undertake various exercises to ensure that the data they collate and process is of high quality. A thorough check of data is also done before tabulation and international norms and definitions are meticulously followed. These aspects are dealt in detail in Chapter 6.

Cancer registration is a means to a purpose and not a purpose in itself. It is the forerunner of studies in descriptive epidemiology of cancer, which in turn generates specific scientific hypotheses for analytical studies. The cancer registry is central to any rational programme on cancer control *(Muir C.S., 1985)*. The results of this report on a special purpose PBCR have provided a lead to set priorities for cancer research. Data needs to accrue for further years especially in certain anatomical sites where meaningful analysis or interpretation could not be carried out due to small numbers. This includes the lymphoid and haemopoietic malignancies, soft tissue tumours and so on. The former have been shown to have a higher incidence in the atomic bomb survivors of Hiroshima and Nagasaki *(Prestone et al, 1994)*.

Despite the meticulous effort put in by the Bhopal Cancer Registry and the staff therein, in data collection and the quality control exercises carried out further by the Coordinating Unit of NCRP certain unavoidable limitations remain. These include misclassification of cancer cases between the two areas on account of migration between the two areas, incorrect address etc. though care has been taken to randomly check the authenticity of residence of cancer cases. A second limitation is that the worst affected cases due to the MIC exposure have died almost instantly, and the data available is only of those who have survived. Lastly, the system of registration and certification of cause of death in our country does not provide complete and accurate information on cancer mortality. In more recent years all cause mortality data is matched with the incident cases improving the Mortality Incidence ratio. Since such data was not available for earlier years data or interpretation on cancer mortality has not been provided in this report. Despite these limitations the report has provided scientific results of the effect of MIC exposure on the occurrence of cancer in Bhopal.

Dr A. Nandakumar
Officer-in-Charge, NCRP

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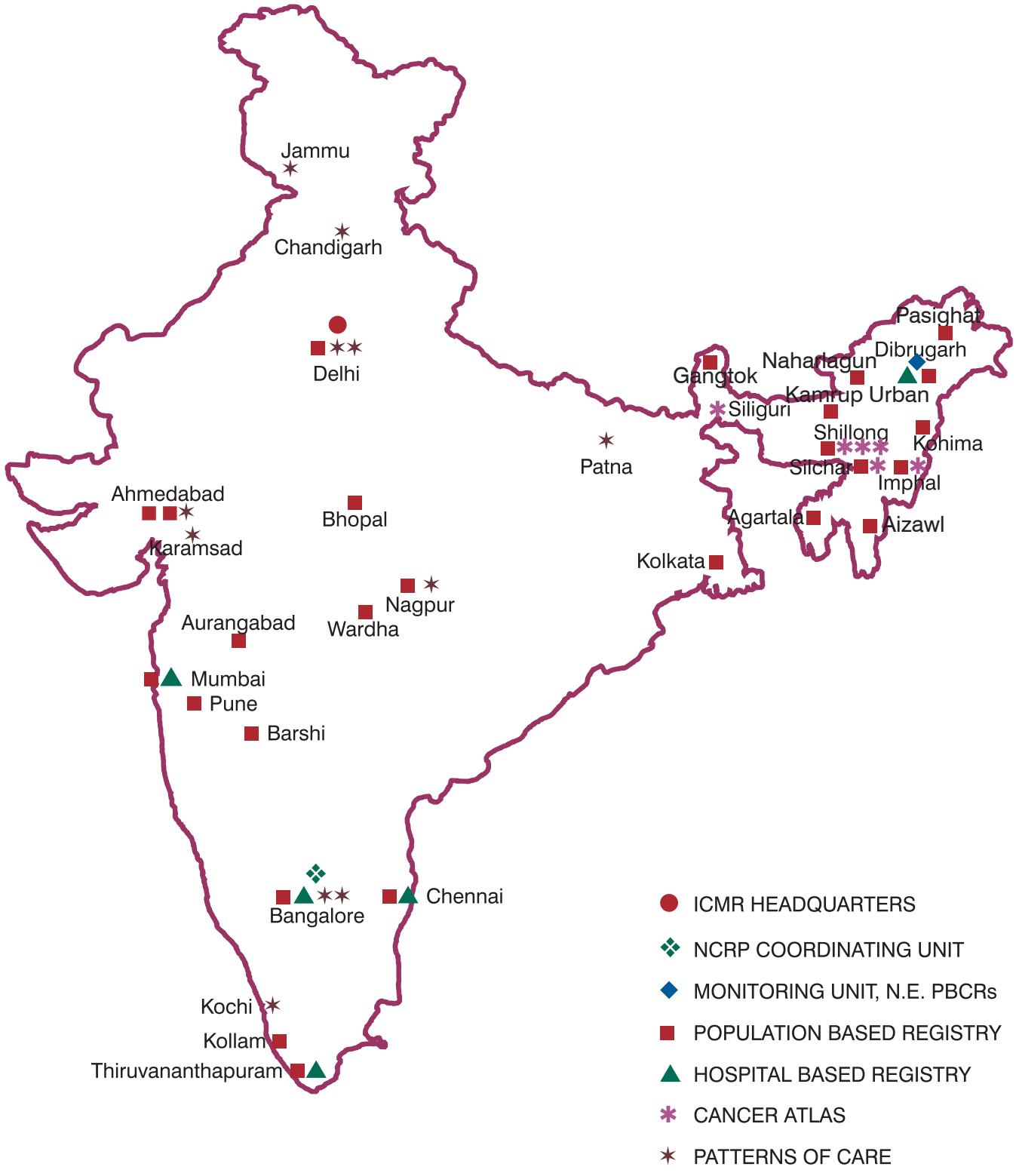
Figure 1.1: NCRP Network