CANCER
REGISTRY
ABSTRACT

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CANCER REGISTRIES IN INDIA (2006)
Under the National Cancer Registry Programme of India

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Dibrugarh

Guwahati

Sikkim

Silchar

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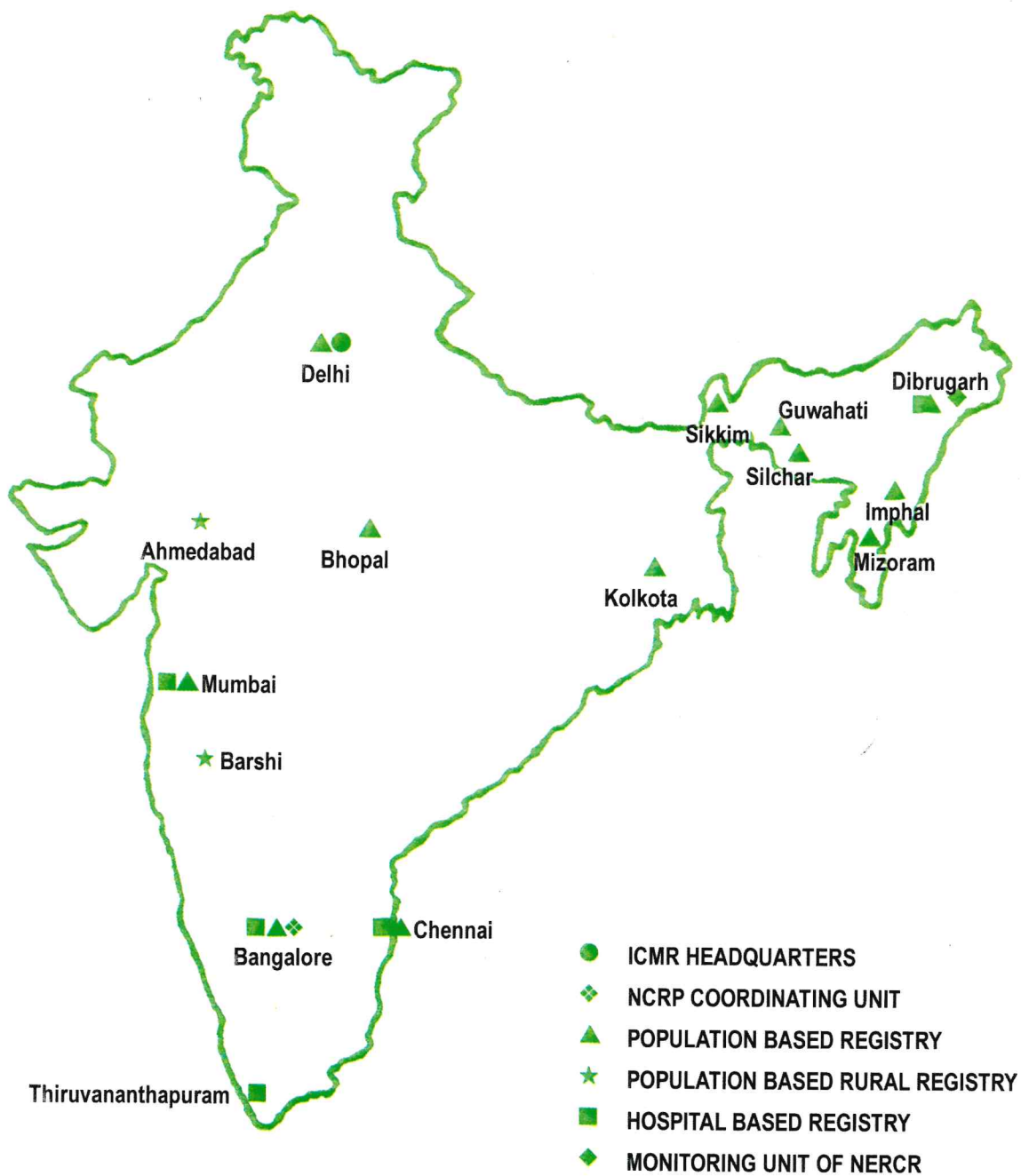
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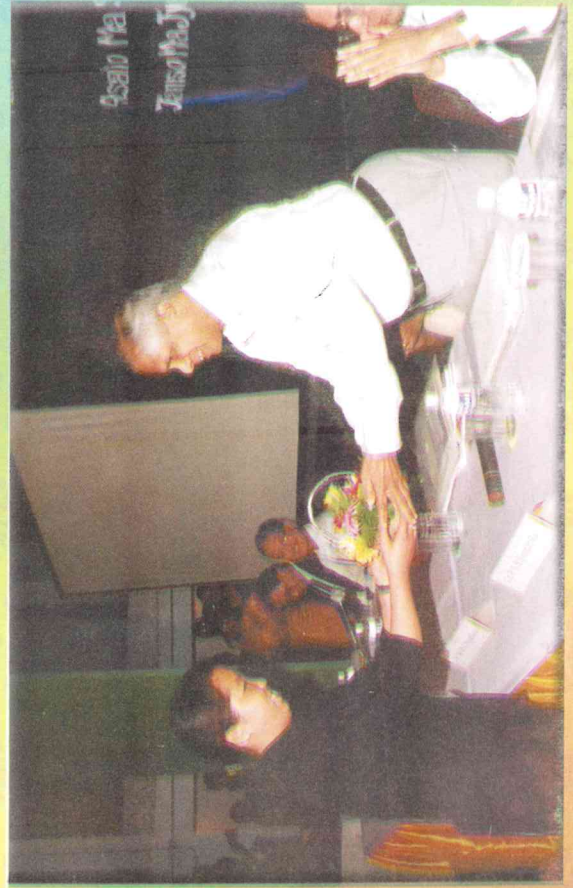
XXI Annual Review Meeting
of
National Cancer Registry Programme (ICMR)
9-12 November 2005
Cancer Centre Welfare Home & Research Institute
Thakurpukur, Kolkata

PREFACE

This issue of "CRAB" consists of three sections. The first section utilizes the cancer registry data to provide information such as comparison of distribution of age at diagnosis with age at mortality, head and neck cancers in the north east, time trend in new patient registration in a comprehensive cancer institute in eastern India, time delay in management of cancer after diagnosis and time trend in thyroid cancer patient registration at Regional Cancer Centre, Thiruvananthapuram. Prevalence of tobacco use in Barshi rural cancer registry population is also given in this section. The second section depicts some of the statistical methodologies in population-based cancer survival analysis, basic statistical terms used in cancer registries, methods to deal with small numbers and case-finding methods in cancer registries. Some of these methodological papers were presented at the NCRP pre-ARM workshop held at Cancer Centre Welfare Home & Research Institute, Thakurpukur, Kolkata, 2005. The third section lists highlights of activities from various cancer registries under the network of the national cancer registry programme.

The lapses in the publication may kindly be excused. We did not have enough time to discuss with the contributors some of the points made by them due to shortage of time.

We are certainly concerned the quality of the publications received and the poor response of the registries at large. We need to seriously think of the methods by which this newsletter could be made more meaningful and valued by the scientific community.

We thank all the contributors.

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CONTENTS

CANCER EPIDEMIOLOGY AND CANCER REGISTRIES IN INDIA

Globally, nearly 12 million persons are reported to have developed various cancers in 2005, of which half are from developing countries. In India, it is estimated that at least 800,000 develop cancer each year. Despite much research into the prevalence, incidence and aetiology of cancers, there are still many gaps in our knowledge, especially in the understanding of its epidemiology, management and prevention.

Epidemiology is an established science to describe the inter-relationships of an agent to produce disease or disability or death in the host in a given environment, be it physical, biological, social or cultural. Traditional techniques of epidemiology include analysis of trends over time or across geographical areas, and evaluation of risk factors in the occurrence of disease and in estimating effectiveness of various therapies. Clinical epidemiology is a more recent subgroup of epidemiology, and has become a powerful tool in developing valid evidence bases for clinical and experimental medicine.

The Indian Council of Medical Research (ICMR) has taken advantage of several well established cancer registries in India; has established population-based and hospital-based network of registries in 1982. Over the past two decades, the Coordinating Unit of the National Cancer Registry Programme (NCRP) of ICMR has guided, standardized, enhanced the quality of data collected, and has provided computerized statistical software to clean, edit, and process the raw data into meaningful epidemiological information to be used for research, training of cancer personnel, enhancing clinical services and in cancer control programmes.

However, we are yet to reap the benefits of the NCRP in implementing relevant and urgently needed epidemiological research. With the vast core of trained staff, plethora of data collected meticulously over the past 25 years, we have barely scratched the surface of epidemiological research in India. Our research and scientific publications are very general, merely confirm what is already well known and rarely deal with indepth investigations into the processes and specific risk factors of common cancers in India, some of them peculiar to certain regions, such as cancers of the gall bladder, stomach, oesophagus, etc. Given the ageing and changing population in India, we have not even attempted to exploit the valuable data of NCRP to study cancers of the prostate, breast and cervix uteri. Further, very little research efforts are directed towards paediatric cancers, and explored the role of childhood factors or nutritional habits in the manifestation of cancers in the adults.

Where else can one find such a gold-mine of cancer data as in NCRP? What ails our researchers? Do we lack resources or specific skills? I don't think so. It is high time that we all make up our minds to make epidemiological research our highest priority, so that the outcomes of this research will benefit the vast sufferers from cancer, and reduce this scourge through appropriate preventive measures.

I strongly believe that we have the necessary talent, resources and opportunity to become a world leader in epidemiological research and be the torch bearer for focused cancer research.

P S S Sundar Rao,
Chairman, Steering Committee,
National Cancer Registry Programme (ICMR)

Section I

Cancer registry data utilized

A COMPARISON OF DISTRIBUTION OF AGE AT DIAGNOSIS WITH AGE AT MORTALITY OF CANCER CASES - DOES IT HELP IN ESTIMATION OF DURATION OF DISEASE?

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In cancer studies, duration of disease is of great interest for assessing the effectiveness of a given treatment, for understanding the biological behaviour of tumours, estimating the prevalence of the disease, defining the follow-up intervals for cancer patients as well as for computing the comprehensive index such as disability adjusted years of life lost. Direct estimation of duration of disease from cancer requires follow-up of cancer patients over a long period either by passive or active means till the occurrence of terminal event or by conducting survival studies. In developing countries, problems are enormous in the conduct of such cancer survival studies (Mathew, 1996; Ganesh, 1995). In India, the survival data available from various registries show a high proportion of loss to follow-up (Desai et al 1969, Nandakumar, 1993). Hence, indirect approaches are needed for estimation of duration of cancer disease. The estimation of such indexes on the basis of other indirect statistics, such as mortality, can therefore be of great use. It has been suggested that survival and therefore duration of disease is inherent in the cancer incidence and mortality data (Pollard, 1980). In the present communication, we propose an indirect procedure for an approximate estimation of duration of cancer for "all sites" as well as for leading sites. Estimation of duration of disease has a great potential to identify cancers which have a poor survival and in turn for undertaking research activities to improve the survival of cancer patients.

Materials and methods

The data on occurrence of cancer incidence and mortality in the country is available from the Population-Based Cancer Registries (PBCRs) established in various parts of India. A total of 22 PBCRs operate in the country. Because of certain difficulties in the collection of mortality data in the country and as the National Health Information is still in the process of development, it is not possible to have a clear and complete picture of mortality data from the various registries as opposed to cancer morbidity data. However, Mumbai has developed a relatively better Health Information System and has made efforts to provide reliable morbidity and mortality data.

The published data on age, sex and site specific cancer incidence and mortality for the years 1999-2000 of the PBCR, Mumbai formed as the basic material for computations (NCRP, 2005). The details of data collection, quality control measures adopted by the registry and the indices of reliability have been published elsewhere (NCRP, 2005). The various cancer sites reported are based on the tenth revision of International Classification of diseases.

Statistical analysis

The age, site and sex-specific distribution of cancer incidence and mortality data for the above mentione period was entered in an MS-Excel sheet. In view of skewness in the age distribution, we calculated th median age at diagnosis of cancer, and median age at death for the various leading sites and for 'all sites' t sex (NCRP, 2005). The statistical significance of difference in median ages were tested employing Man Whitney U statistic while the age-adjusted rates were tested using Z-statistic. The calculation of duration disease was based on the differences in the median ages between cancer incidence and cancer mortali Further, ratio of mortality to incidence (M/I %) was also estimated for the various leading sites as well for "i sites" to know the prognosis. Rank correlation coefficient was computed to evaluate the relationship betwee duration of disease and M/I %. In order to validate the authenticity of the findings of the present study, medi survival period was estimated based on 1, 3 and 5 year cumulative survival probability from some of th published data (Nandakumar et al., 1998, Jayant et al., 1998, Shanta et al., 1998 and Yeole et al., 1998) ar compared with the median duration of disease estimated from the present study.

Assumptions in the estimation of duration of disease

The mortality experience of a group of incident cancer patients diagnosed in a particular year would be simil to the cancer mortality patterns reported during the same year.

Results

Table 1 shows the age adjusted incidence & mortality rates, age at incidence & mortality and average duratic of disease by sex for all sites of cancer.

Age adjusted incidence rate & Median age at incidence from cancer

A total of 8868 males and 8674 female incident cancer cases were registered during the period 1999-2000 Mumbai registry (after excluding the unknown ages). For the calculation of incidence rates 6.6% of data wa from the death certificates (DCOs) (NCRP, 2005). Majority of cases (81.3% males and 82.8% female) ha microscopic verification. The age-adjusted incidence rate of cancer for all sites during the above period wa 116.5 and 125.3 for males and females respectively per 100,000 populations.

Distribution (%) of age at diagnosis for the year 1999-2000 for "all sites" together is presented in Tab 1. Seventeen percent of incident cases were below 40 years amongst males and females while 35.5 and 33 percent were above the age of 65 years. Amongst males, the median age at incidence for 'all sites' was four to be higher (58.9 years) as compared to females (54.7 years), which was found to be statistically significa (p<0.05).

Age adjusted mortality rate & Median age at mortality from cancer

The number of deaths due to cancer in males and females were 4261 and 3586 during the years 1999-200 after excluding unknown ages. The age-adjusted mortality rates for 1999-2000 for 'all-sites', were found to t 61.4 for males and 58.2 for females per 100,000 population. Thus, a higher death rate was observed among males as compared to females, which was found to be statistically significant (p<0.05) (Table 1).

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The distribution of mortality also was found to follow the general pattern of increase in higher ages. Fourteen percent of cancer deaths were below 40 years amongst males and females while 45.5 and 52.2 percent were in the age group of 40 to 64 years. Around 41 and 34 percent deaths were above the age of 65 years in males and females respectively. The median age at death was found to be higher for males (61.4 years) as compared to females (58.2 years). The differences were found to be statistically significant (p<0.05).

Duration of disease from cancer and M/I %

Median duration of cancer for females (3.6 years) was found to be higher as compared to males (2.5 years). The mortality/incidence (M/I) ratio was high amongst males (48.0%) as compared to females (41.3%) indicating a poorer survival amongst male cancer patients.

Table 2 shows the age adjusted incidence & mortality, age at incidence & mortality and average duration of disease of leading cancer sites by sex.

Age adjusted incidence rate & Median age at incidence

The major cancer sites among males were lung, oesophagus, hypopharynx, larynx, stomach, mouth and tongue, which together accounted for 45% of all male cancers. Among females, the leading cancer sites were breast, uterine cervix, ovary, oesophagus and mouth. The median age at incidence of cancers such as breast, cervix and ovary amongst females were in the early fifties as compared to other leading cancers in men such as lung, larynx, stomach, esophagus etc. which were all beyond 60 years. The median age at incidence of cancer of mouth amongst males was in the mid fifties. However, median age at diagnosis of brain tumors (CNS) amongst males and females were 44 and 48 years respectively.

Age adjusted mortality rate & Median age at mortality from cancer

Females had higher mortality rates from many cancers such as breast, cervix uteri and other reproductive organs as compared to cancers in males. The age-adjusted mortality rate was found to be highest for female breast cancer (10.5 per 100,000 persons) followed by cervix uteri (5.9 per 100,000 persons). Amongst males, the highest mortality was noted for lung cancer (7.2 per 100,000 persons). Median age at mortality amongst females for cancers such as breast and other reproductive organs was between 55 to 59 years. In males, the corresponding median age at mortality for cancers such as lung, esophagus, larynx and prostrate were all beyond 60 years of age.

Duration of disease from cancer and M/I %

Based on the differences in median age at incidence and mortality, the duration of disease was found to be in the range of 4-6 years for cancers such as NHL, brain (both males and females) and cancer of ovary. For cancers, such as tongue, stomach (males), female breast and uterine cervix, the duration of disease was between 2-3 years. Cancers of the mouth (males & females), gallbladder (females), larynx (males) and prostate had duration of disease between 1-2 years. Cancers of lung (males & females), and oesophagus (females) revealed a very low duration of disease.

The mortality/incidence (M/I) ratio was also found to be low for cancers which had higher duration of disease. The M/I ratio varied from 18.3% to 60.0% and was found to be highest for lung cancer, which has a very poor prognosis. The rank correlation coefficient between duration of disease and M/I % was found to be 0.56. However, this was not statistically significant.

Comparison of present study findings with published survival data (Table 3)

In order to validate the authenticity of the findings of the present study, median survival period was estimated based on 1, 3 and 5 years cumulative survival probability from some of the published data and compared with the median duration of disease estimated from the present study.

It may be noted that wherever survival results are available from more than one study, a variation in the median survival is observed. The median survival duration for breast cancer varied from 3.8 to 5.2 years. In the present findings the duration was 3.3 years. On comparison of the present study findings with the estimates of median duration of disease in Mumbai, or with findings of other studies (wherever findings from Mumbai are not available), the underestimation with the present study findings (median duration of disease) are nearly 30-40 percent.

Discussion

Although several population-based registries are operating in the country, reliable mortality data is available only for Mumbai registry and a few other registries, which are of recent origin. In India, cause-wise mortality rates in the country/state level are not available as the National Health information is still in the process of development. The present exercise was limited to mortality data obtained from Mumbai PBCR only. The death registration system in Mumbai seems to be fairly reliable and accurate. No dead body can be disposed off without a death certificate from a competent authority and all deaths have to be certified by a registered medical practitioner as per law. Measures such as cancer incidence, mortality, mortality/ incidence ratio and survival data provide a means to assess the effectiveness of overall cancer services.

The results of our analysis represent the average duration of disease from cancer in Mumbai. There have not been many reports on survival from cancer in India, mainly because of poor patient follow-up and inadequate system of registration of death. In the absence of carrying out well- conducted survival analysis and considering the ways to obtain average duration of disease at minimal cost, the present method may be one of the procedures. The present study indicates that median duration of disease for all sites as 2.5 and 3.5 years for males and females respectively. Higher duration of disease observed amongst females may be due to better prognosis for certain cancers amongst females. In males, cancers such as

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Table 1. Distribution (%) of age at diagnosis and death, age adjusted incidence & mortality rates (AARs) per 100,000 populations, median age at incidence and death, average duration of disease (ADD) and ratio of mortality to incidence - Mumbai (1999-2000), All sites of cancer

Age (Years)	Males		Females	
	Incidence (N=8868)	Mortality (N=4261)	Incidence (N=8674)	Mortality (N=3586)
00-04	1.5	1.6	0.8	1.1
05-09	1.2	1.1	0.8	0.8
10-14	1.4	1.1	0.9	0.9
15-19	1.7	1.6	1.0	1.0
20-24	1.7	1.4	1.3	1.0
25-29	2.2	1.4	2.5	2.0
30-34	2.8	2.1	3.6	2.0
35-39	4.6	3.4	6.9	5.0
40-44	6.0	5.3	9.0	7.5
45-49	7.5	6.7	11.9	10.3
50-54	10.4	10.1	12.2	10.6
55-59	11.7	10.8	10.9	12.2
60-64	11.9	12.6	11.0	11.6
65-69	12.6	13.5	10.7	12.6
70-74	10.3	12.1	7.7	9.0
75+	12.6	15.3	8.9	12.4
AAR	116.5 (1.33)*	59.0 (0.96)*	125.3 (1.41)*	54.5 (0.94)*
Median age (Yrs.)	58.9	61.4	54.7	58.2
ADD – based on Median (Yrs.)	2.49		3.57	
Ratio of Mortality to Incidence (%)	48.0		41.3	

Source: NCRP (2005); N = No. of subjects studied. *Figures in parentheses are standard errors.

lung, oesophagus and oral cancers have the worst prognosis. Further, analysis according to various sites indicated that the magnitude of cancer problem is more pronounced in females as compared to males mainly due to the high risk of development of breast and cervical cancers and other cancers of female genital organs that occur in the reproductive age groups. Brain (CNS) tumors although showed an early age at incidence had a duration of 4 - 6 years.

Survival data are lacking from populations in developing countries. Only a few survival studies have been carried out in India for different cancer sites (Nandakumar et al 1995a, 1995b, 1998; Jayant et al, 1996b, 1998, Yeole et al, 1998; Shanta et al 1998). Most of the survival studies carried-out relate to cancers of cervix and breast. A large cohort of a survival study carried out in Mumbai reveal that the five year relative survival was 51% and 55% for uterine cervical and breast cancers respectively.

The present estimate refers to duration of disease from date of diagnosis to date of death from cancer. The duration from date of symptoms to date of diagnosis has not been accounted in the present computations. Mandal et al (2001) in a retrospective study on 3638 cancer patients has shown that only 83 patients (2.85%) reported within one month of the initial onset of symptom. The vast majority of patients (97.15%) reported at the hospital after several months of appearance of symptoms, contributing to a moderate to advanced stage of their disease at first contact. As such, the present estimate of duration of disease may be an underestimate of the actual duration of disease.

In the present study, the duration of disease was calculated based on two different cohorts of subjects. viz. on the experience of incident cases and death cases belonging to another group and only a few members of the two cohorts may be common, i.e. those who developed the disease during the same year and died. However, under the assumption that mean age at incidence and mortality may not change appreciably to a great extent over time period, the computation of duration of disease may not get affected to a great extent since there are no organized screening programmes in the country.

As the present study findings are based on secondary data, a few biases may be present in estimation of duration of disease. There is a considerable scope for improving the estimate with primary data. Further there may be some bias in the estimate of mean duration of disease, as only cancer deaths alone have been taken into consideration. Cancer patients dying from causes other than cancer have not been considered. This bias may cause an underestimate in the computation of mean duration of disease. Further, it was not possible to exclude the cases, which were included from death certification (DCO) as the present analysis for estimating the average age at incidence was based on secondary data. Inclusion of such cases would cause under estimation of mean duration of disease as age reported in case of DCO is in fact the age at death and not age at incidence of the disease.

The possible reason for observing a high discrepancy between the published survival rates from Indian studies and our estimates could be due to the established practice of recording age in terms of completed years. As such, diseases which have a poor survival get affected to a greater extent due to the reason that a person developing the disease and dying within the interval of successive birth anniversaries get recorded with age at incidence and at death as same. This results in zero survival.

Some of the recommendations

It is hoped that the present effort will further encourage more refined studies which would be economically viable in the estimation of duration of disease. Many of the biases discussed above can be taken care if the analysis is attempted on primary data. Matching of incident cases of cancer with death certificates, which has cancer or tumour as cause of death, removal of DCOs from the computations and inclusion of cancer cases that die from other causes will further improve the estimation of duration of disease.

Table 2. Age adjusted (incidence & mortality) rates (AAR), median age at incidence and mortality and average duration of disease for leading sites of cancer, Mumbai, 1999-2000

Site and sex	Incidence			Mortality			Duration of disease	M/I ratio (%)
	Number of cases	AAR*	Median age (Yrs)	Number of cases	AAR*	Median age (Yrs)		
Common sites								
Lung, Males	802	11.7	63.2	481	7.2	64.0	0.83	60.0
Lung, Females	238	3.8	61.6	143	2.3	61.0	-0.60	60.1
Oesophagus, Males	525	7.5	61.5	302	4.3	61.5	0.00	57.5
Oesophagus, Females	360	5.8	61.9	200	3.3	62.3	0.34	55.6
Mouth, Males	524	6.2	54.4	187	2.3	56.5	2.12	35.7
Mouth, Females	295	2.6	58.5	120	1.9	58.8	0.26	40.7
NHL, Males	451	5.2	52.2	242	3.1	57.2	5.02	53.7
NHL, Females	247	3.5	56.0	147	2.3	62.3	6.37	59.5
Brain (CNS), Males	402	4.1	43.9	159	1.8	48.5	4.61	39.6
Brain (CNS), Females	279	3.6	47.9	114	1.6	52.3	4.46	40.9
Non-commom sites								
Males								
Larynx	524	7.4	61.6	212	3.1	63.3	1.77	40.5
Prostrate	505	8.9	72.0	240	4.3	73.9	1.93	47.5
Tongue	399	5.0	57.4	147	2.0	60.8	3.39	36.8
Stomach	380	5.2	61.1	223	3.2	62.7	1.63	58.7
Hypopharynx	345	4.8	61.6	153	2.2	61.8	0.19	44.3
Females								
Breast	2231	31.5	52.7	707	10.5	56.0	3.25	31.7
Cervix uteri	1240	17.4	52.6	395	5.9	55.4	2.83	31.9
Ovary	577	7.9	51.9	232	3.4	56.5	4.58	40.2
Corpus uteri	214	3.4	58.1	39	0.6	58.4	0.35	18.2
Gallbladder	201	3.2	61.6	92	1.5	63.3	1.72	45.8

Source: NCRP (2005); *AAR=Age adjusted rate per 100,000 person years; NHL=Non-hodgkin's lymphomas; M/I=Mortality/Incidence

Table 3. Survival rates reported by various Indian studies and estimated median duration

Site, author and year	Number included	Observed survival (%)			Median duration (Years)
		1-year	3-year	5-year	
Female breast cancer					
Yeole et al, 1998	2872	84.2	61.9	51.1	5.2
Nandakumar et al, 1998	1361	82.2	55.5	41.7	3.8
Shanta et al, 1998	1346	82.3	57.2	45.9	4.3
Present study, 2006					3.3
Uterine cervical cancer					
Yeole et al, 1998	2354	81.0	56.0	47.7	4.4
Nandakumar et al, 1998	2155	76.4	50.5	37.6	3.1
Shanta et al, 1998	3289	87.9	67.4	56.3	6.1
Jayant et al, 1998	247	62.8	36.2	30.9	2.0
Present study, 2006					2.8
Non-hodgkin's lymphoma					
Nandakumar et al, 1998	428	59.7	42.2	31.6	2.1
Shanta et al, 1998	362	57.2	31.9	19.4	1.6
Present study, 2006					5.7'
Tongue cancer					
Shanta et al, 1998	432	66.8	35.6	22.7	2.1
Present study, 2006					3.9
Mouth cancer					
Shanta et al, 1998	931	76.0	43.7	28.8	2.6
Present study, 2006					1.5
Hypopharyngeal cancer					
Shanta et al, 1998	536	58.6	28.4	15.5	1.6
Present study, 2006					1.2
Oesophageal cancer					
Shanta et al, 1998	969	49.1	11.3	5.6	1.0
Present study, 2006					0.2
Stomach cancer					
Shanta et al, 1998	1313	44.9	15.2	6.9	0.9
Present study, 2006					1.8
Laryngeal cancer					
Shanta et al, 1998	346	70.7	45.6	33.9	2.6
Present study, 2006					2.0
Lung cancer					
Shanta et al, 1998	656	40.3	10.6	6.6	0.8
Present study, 2006					0.5

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TIME TREND IN NEW PATIENT REGISTRATION IN A COMPREHENSIVE CANCER INSTITUTE IN EASTERN INDIA

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Introduction

Cancer Centre Welfare Home & Research Institute (CCWHRI) at Thakurpukur, Kolkata was established in 1976 as a 25 bedded shelter for cancer patients who came to Kolkata for treatment in different city hospitals but did not have a place to stay. It was established by a philanthropic society registered in 1973 with about 40 members that included some oncologists. Since then, with help and donations from various sources, it has become one of the most important comprehensive Cancer Institutes in eastern India. It is still managed by the same voluntary society. This Institute is now a 260-bedded hospital with facilities of all modern treatment for cancer. The annual new patient registration is more than 7,000. This Institute receives patients from Kolkata, other districts in the state of West Bengal, from the neighboring states of West Bengal and from neighboring countries like Bangladesh, Nepal and Bhutan. The present communication analyze the time trend in new patient registration and their geographical distribution.

Material and Methods

Data were mostly obtained from the Annual Reports of the Institute. Hence, the years as mentioned in this communication are the financial years (1st April of one year to 31st March of the next). Although the hospital was established in 1976, the out patient services were started only during 1980-81. Hence data on registration is reported from this period onwards. Some of the detailed data of the earlier periods (upto 1983-84) were obtained directly from case records by the present author after he joined this Institute in 1982.

The geographical areas from where the patients attend this Institute have been designated as Greater Kolkata (KOL), Other Districts of West Bengal (WBD), Other States of India (IND) and Neighboring Countries (NBC). Distribution (%) of newly registered cases of each year according to the above 4 designated geographical areas is presented. In the present communication, data on geographical distribution of the patients have been given only from the year 1984-85 as older data (1980-81 to 1983-84) could not be properly retrieved.

Results

Table 1 shows the data on new patient registration and the proportion of diagnosed cancer cases between the years 1980-81 and 2004-05. It is seen that the number of new patients registered in this Institute has increased from 595 to more than 7,000 in about 11 years (from the year 1980-81 to 1991-92). The figures in the subsequent years remained stable between 7,000 to 8,000 cases (Figure 1). The relative proportion of diagnosed malignant cases out of all newly registered cases was comparatively high (70-80%) in the initial 9 years. The figures settled at around 60% from the 10th year (1989-90) onwards. A time trend analysis was done and the nature of data fitted to a logarithmic trend [y=-6.5435 Ln(x) + 83.943] with a negative gradient (Figure 2).

The proportion of patients coming from other districts of West Bengal (WBD) and other states of India (IND) remained almost constant at around 50% and 10% respectively throughout the entire period. However, the proportion of patients coming from Greater Kolkata (KOL) showed a declining trend from 44% to around 14% in about two decades (1984-85 to 2004-05). It is also seen that the proportion of patients coming from neighboring countries (NBC) showed a gradual rise from a negligible 0.1% to more than 20% during the same period (Table 2 & Figure 3).

Figure 4 shows the magnitudes of the decline of KOL and the increase of NBC, the yearly absolute figures for these two geographical zones have been calculated based on registration figures and the proportion of geographical distribution. Fitted trend lines of both KOL & NBC in polynomial (n=2) have shown that there is a definite fall in the absolute numbers of patients coming to this Institute from Greater Kolkata over the last two decades. It is also seen that there has been a remarkable rise of the same for the people coming from the neighboring countries.

Discussion

The increase in number of new registration every year has been substantial in this Institute for the first 11 years. The numbers have kept pace with infrastructural development of the Institute like better diagnostic and therapeutic facilities, increasing number of beds (from 25 to 260), increasing numbers of medical and paramedical staff etc. However, after the 12th year, there has not been substantial increase in the numbers although developments in the hospital continue till date. It seems that the number of new registration has reached a saturation point. This

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finding is more significant as it is a fact that recent developments in the therapeutic and diagnostic facilities in this Institute have been very significantly resource intensive. The fall in the absolute numbers of freshly registered cases from Greater Kolkata could be contributory to this phenomenon. In a previous communication (Dey et al.2004), it has been shown that there is a referral bias of this center for radiation therapy. Compared to PBCR Kolkata, the HBCR of this Institute shows a preponderance of patients with diseases that are primarily treated by radiation therapy. Thus the cause of the fall in absolute numbers of patients coming from Greater Kolkata may be due to improvement of radiation therapy facilities in the existing oncological units of Kolkata. Proportionately more people in Greater Kolkata are perhaps availing these facilities. The static pattern of time trend for patients coming from other districts of West Bengal and other states of India and the increasing load of patients from neighboring countries (notably Bangladesh) is perhaps a reflection of the fact that this Institute is the most affordable comprehensive cancer care Institute in this part of the country. People coming from outside perhaps prefer this Institute because they have to spend less time in diagnosis and treatment. This Institute continues to be basically philanthropic in nature and hence the cost of diagnosis and treatment also remains more affordable to the common people.

Conclusion

This Institute is a unique model in its conception and functioning. By analyzing the time trend pattern of the patients, the positive and negative aspects of the model can be interpreted. With such interpretations, one can plan to modify and improve the system so that the institute continues to serve the people of a developing country in the most cost-effective way.

References

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2. Dey A, Nandi C & Bandyopadhyay MN: A comparative study between Population Based Cancer Registry Calcutta (PBCR-C) and Hospital Based Cancer Registry, CCWH & RI, Thakurpukur (HBCR-T), Calcutta matched for population and period. CCWH & RI Bull. 1 (3), 4-22, 2004.

Table1: Number of new patients and the number & proportion of cancer patients (1980-81 to 2004-05) at CCWHRI

Year	New Regn	Diagnosed	%
80-81	595	503	84.54
81-82	1545	1179	76.31
82-83	2197	1754	79.83
83-84	2649	2071	78.18
84-85	3286	2161	65.76
85-86	3894	2441	62.68
86-87	4636	3616	77.99
87-88	5236	4288	81.89
88-89	6194	5021	81.06
89-90	7390	4255	66.58
90-91	7394	4100	64.10
91-92	7176	5081	70.80
92-93	7088	4558	64.30
93-94	7539	4874	64.65
94-95	8095	5068	62.61
95-96	7797	4759	61.04
96-97	8311	4873	58.63
97-98	7615	4546	59.70
98-99	7905	4991	63.14
99-00	8172	5181	63.40
00-01	7896	5065	64.14
01-02	7637	5111	66.92
02-03	7056	4802	68.05
03-04	7322	4849	66.22
04-05	7333	4877	66.51

Figure 1 : Trend of absolute numbers of annual new registration at CCWHRI from 1980-81 to 2004-2005
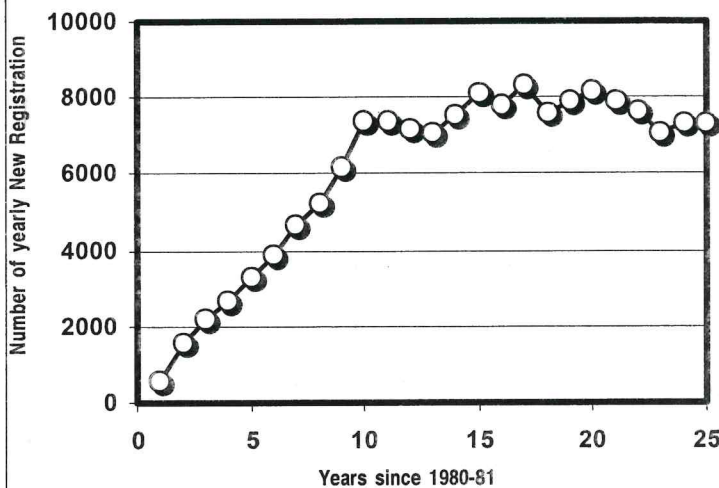
Figure 2: Distribution of (%) of cancer cases among the newly registered cases (1980-81 to 2004-05). The distribution fits to a logarithmic trend line with a negative gradient

$y = -6.5435Ln(x)+83.943$

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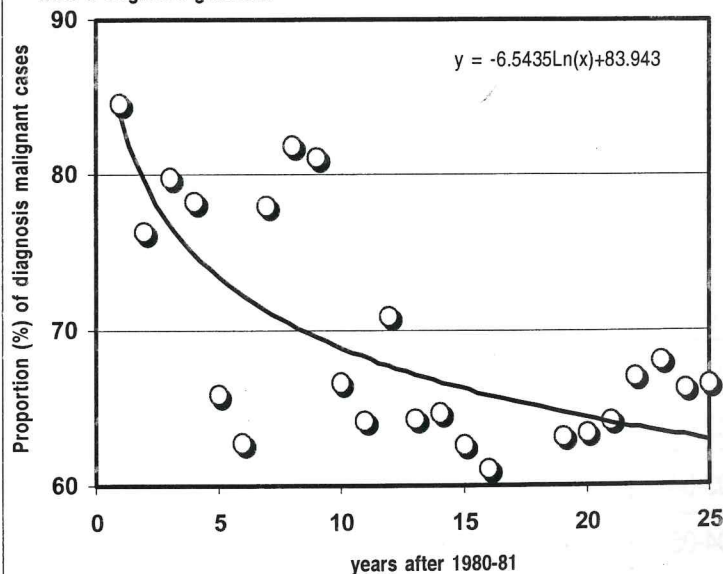
Table 3: Number (#) and proportion (%) of patients from 4 geographical zones: Greater Kolkata (KOL), Different Districts of West Bengal (WBD), Different States of India (IND) and Neighboring Countries (NBC) (1984-85 to 2004-05).

Year	KOL		WBD		IND		NBC		Total
	#	%	#	%	#	%	#	%	
84-85	1463	44.50	1619	49.30	201	6.10	3	0.10	3286
85-86	1714	44.00	1985	51.00	191	4.90	4	0.10	3894
86-87	2026	43.70	2284	49.23	311	6.70	15	0.30	4636
87-88	1663	31.76	2781	53.11	748	14.28	44	0.85	5236
88-89	1990	32.12	3160	51.02	949	15.33	95	1.53	6194
89-90	2047	27.70	4242	57.40	975	13.20	126	1.70	7390
90-91	2453	33.16	4007	54.20	781	10.57	153	2.07	7394
91-92	2081	29.00	3990	55.60	832	11.60	273	3.80	7176
92-93	2310	32.60	3701	52.20	744	10.50	333	4.70	7088
93-94	2277	30.20	3928	52.10	837	11.10	497	6.60	7539
94-95	2615	32.30	3675	45.40	1198	14.80	607	7.50	8095
95-96	2021	25.92	4192	53.76	835	10.71	749	9.61	7797
96-97	2163	26.03	4452	53.57	759	9.13	937	11.27	8311
97-98	1856	24.37	4087	53.67	703	9.23	969	12.73	7615
98-99	1739	22.00	4348	55.00	711	9.00	1107	14.00	7905
99-00	1553	19.00	4495	55.00	817	10.00	1307	16.00	8172
00-01	1422	18.00	4185	53.00	868	11.00	1421	18.00	7896
01-02	1102	14.43	3969	51.97	910	11.92	1656	21.68	7637
02-03	981	13.90	3646	51.67	970	13.75	1459	20.68	7056
03-04	986	13.47	3654	49.90	894	12.21	1788	24.42	7322
04-05	1069	14.58	3670	50.05	924	12.60	1670	22.77	7333

Figure 3 : Time trend of yearly distribution of patients from 4 different geographical zones : Greater Kolkata (KOL), Different districts of West Bengal (WBD), Different states of India (IND) and Neighbouring countries (NBC) (1984-85 to 2004-05)
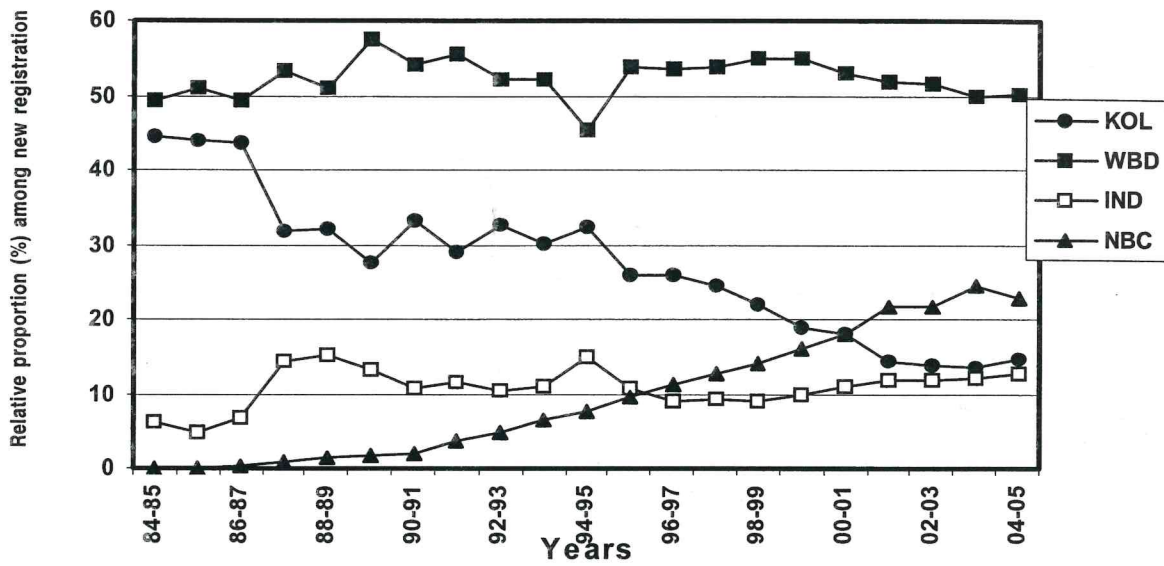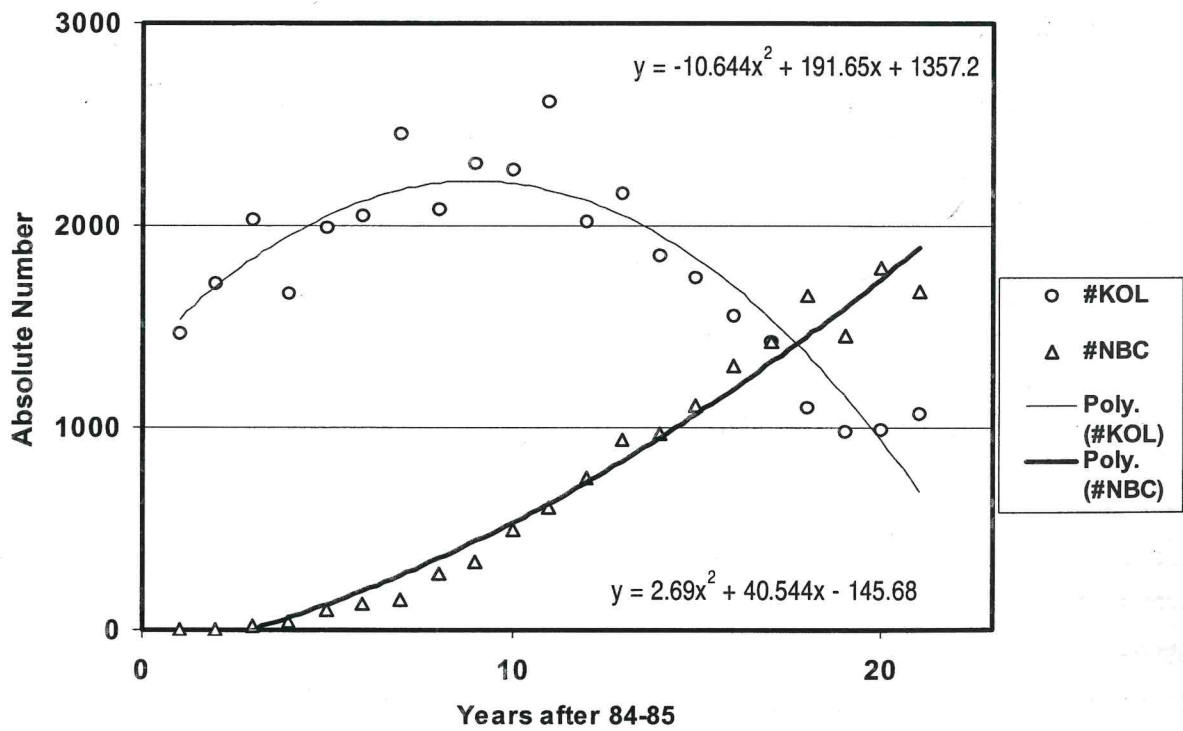

Figure 4 : Time trend of absolute number of patients attending CCWHRI from two geographical zones : Greater Kolkata (KOL) and Neighbouring Countries (NBC). Both the distribution patterns fit into polynomial (n=2) trend lines.

$$y = -10.644x^2 + 191.65x + 1357.2$$

$$y = 2.69x^2 + 40.544x - 145.68$$

HEAD AND NECK CANCERS IN THE NORTH-EAST

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North East Regional Cancer Registry (NERCR) was set up in July 2003. NCRP, Bangalore and RMRC, Dibrugarh as monitoring and coordinating units respectively and has six Population Based Cancer Registries under it.

The report of NERCR (2003-2004), published by the NCRP in 2006 has prompted to analyze some of the salient features of descriptive epidemiology of head & neck cancers in north east with special reference to PBCR,Guwahati.

PBCR, Guwahati covers Kamrup urban district of Assam with a population of 900,518 (in 2001) distributed on both sides of river Brahmaputra at the foothill of Nilachal hill, the abode of Goddess Kamakhya. It is situated at 26.11 N-Lat. and 96.46 E-Long. and 200 metres above sea level.

Table 1. Ten leading sites Male - (2003 - 2004), PBCR- Guwahati

ICD-10	Site (Male)	No.	%
C 15	Esophagus	239	18.83
C 12-13	Hypo pharynx	161	12.77
C 33-34	Lung	94	7.41
C 01-02	Tongue	83	6.54
C 03-06	Mouth	68	5.36
C 09	Tonsil	62	4.89
C 32	Larynx	58	4.57
C16	Stomach	56	4.41
C 61	Prostate	36	2.84
C 82-85, C96	NHL	31	2.44

Source NCRP (2006)

Head and Neck Cancers - Epidemiology

Head and neck cancers are basically squamous cell carcinomas of the upper aerodigestive tract (which extends from the surface of the lips to the neck region of the esophagus) and include the oral cavity, larynx and pharynx (comprising oropharynx, hypopharynx and nasopharynx). Other tumors which occur in this area such as brain, thyroid, salivary gland, PNS etc. cover a wide range of morphological entity and have varied geographic distribution.

Cancers of the head & neck are the sixth most common cancers worldwide, with an increasing incidence in developing countries. Although there are a variety of histological types, squamous cell carcinomas predominate among cancers of the upper aerodigestive tract.

World wide pattern

Cancers of the oral cavity, oropharynx and hypopharynx share similarities in their epidemiology, treatment and prognosis. Geographic pattern and trends in incidence vary depending upon anatomical subsites, cancer related risk factors like tobacco and alcohol.

Countries with high incidence of head and neck cancers are India, Australia, France, Sweden, America, Brazil and South Africa. Oral cancer is the most common cancer of head & neck, 11th rank, world wide 3,90,000 new cases are diagnosed per year. Pharynx cancer is less common (65,000 new cases per year), 20th rank, world wide.

Cancers in the mouth and anterior 2/3 of tongue are predominant in developing countries, where as cancer of pharynx is predominant in developed countries and in Central & Eastern Europe.

Global Trend

In most countries, oral and pharyngeal cancers are stable or increasing in the last four decades. Sharp increase in incidence is reported in Germany, Denmark, Scotland, Central and Eastern Europe, Japan, Australia, New Zealand & in USA (non whites).

Larynx cancer

Worldwide about 1,60,000 (2% of total cancer cases world wide) new cases occur annually (18th most common cancer). This is seen more commonly in males (male to female ratio - 12:1 in developing countries, 6:1 in developed countries). High incidence is reported in Southern Europe (France, Italy, Spain), Eastern Europe (Russia, Ukraine), South America (Uruguay, Argentina) and Western Asia (Turkey, Iraq). Mortality for laryngeal cancer is poorly known because death due to cancer of hypopharynx are often misinterpreted as deaths from cancer larynx.

Nasopharyngeal Carcinoma (NPC) : Relatively rare, world wide, 65,000 new cases per year (0.6% of all cancers). High age-adjusted incidence rates (AAR) are reported from population living in or originating from South China. Moderately high AAR seen in other parts of China, south east Asia, North Africa & Inuits (Eskimos) of Canada and Alaska. Decreasing trend in incidence has been observed in some high risk population (Hong Kong).

Pathology of head and neck cancers : Mostly squamous cell carcinoma (varying degree of differentiation). Variants like verrucous carcinoma, sarcomatoid carcinoma, lymphoepithelioma are seen in NPC. Majority are non keratinizing and undifferentiated in endemic whereas keratinizing squamous carcinomas are seen in non endemic areas.

Table 2. Population at risk and number of cancer cases in North-east region (PBCRs under NERCR- 2003 - 2004).

Registry	Population at Risk			Number of Cases Registered		
	Males	Females	Population	Males	Females	Total Cases
Dibrugarh District	12,67,536	11,90,444	24,57,980	764	560	1,324
Kamrup Urban District	10,74,521	9,18,587	19,93,108	1,269	950	2,219
Silchar Town	1,84,247	1,77,988	3,62,235	175	115	290
Imphal West District	4,62,374	4,67,135	9,29,509	317	377	694
Mizoram state	9,84,697	9,25,052	19,09,749	1,209	949	2,128
Aizawl District	3,57,619	3,41,663	6,99,282	620	528	1,148
Mizoram state - Excl. Aizawl	6,27,078	5,83,389	12,10,467	589	421	1,010
Sikkim State	6,26,170	5,47,168	11,73,338	314	323	637

Source NCRP (2006)

Table 3. Incidence rates (per 100,000 populations) in North-east region (2003 - 2004)

Registry	Males			Females		
	CR[1]	AAR[2]	TR[3]	CR	AAR	TR
Dibrugarh District	60.35	89.44	165.35	49.96	66.80	151.15
Kamrup Urban District	118.10	172.23	321.07	103.42	154.09	326.27
Silchar Town	94.98	113.77	192.95	64.61	73.46	148.40
Imphal West District	68.60	90.40	149.30	80.70	95.60	188.30
Mizoram state	122.78	194.53	352.89	102.59	155.73	320.65
Aizawl District	173.37	277.23	506.28	154.54	231.52	457.89
Mizoram state - Excl. Aizawl	93.93	148.64	267.21	72.16	111.14	240.99
Sikkim State	50.15	73.61	136.24	59.03	88.16	174.78

Source NCRP (2006)

[1] Crude incidence rate; [2] Age-adjusted incidence rate; [3] Truncated age adjusted (35-64 years) incidence rate

Tobacco-related cancers : According to the IARC, 1987 the anatomical sites of cancer that have been associated with the use of tobacco (TRC) include lip, tongue, mouth, pharynx (including oropharynx and hypopharynx), esophagus, larynx, lung and urinary bladder.

TRC (IARC-2004) : Nasal cavities, PNS, esophagus (adeno), stomach, liver, kidney (RCC), uterine cervix and myeloid leukemia.

Table 4. Number and relative proportion of tobacco related cancers in NERCR (2003-2004).

Registries	Males		Females	
	#	%	#	%
Dibrugarh District	419	54.77	141	25.22
Kamrup Urban District	760	59.89	265	27.89
Silchar Town	81	46.29	35	30.43
Imphal West District	133	41.95	95	25.20
Mizoram state	409	33.83	186	19.60
Aizawl District	268	43.23	112	21.21
Mizoram state - Excl. Aizawl	141	23.94	74	17.58
Sikkim State	103	32.80	78	24.15

Source NCRP (2006)

Table 5. Age adjusted incidence rates (per 100,000 populations) of Head & Neck Cancers (2003-2004)

Site	DIB		KUD		SIT		IMP		MIZ		AIZ		MIO		SKM	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Tongue	4.7	1.4	12.2	5.8	8.3	1.5	2.7	1.1	2.5	0.2	3.4	-	2.0	0.2	2.1	1.2
Mouth	6.3	3.4	8.7	8.3	5.4	5.5	1.8	2.3	3.5	2.2	6.3	1.4	1.9	2.6	1.3	0.2
Salivary gland	0.3	0.2	0.3	0.3	0.6	0.7	0.5	0.2	0.8	0.7	1.7	1.3	0.3	0.4	0.4	1.1
Tonsil	2.5	0.6	8.2	3.8	1.4	-	1.7	0.3	2.3	0.4	4.5	0.6	1.0	0.2	0.2	1.1
Oropharynx	1.1	0.3	2.9	0.3	2.5	0.8	0.6	0.7	0.6	0.7	1.2	1.2	0.3	0.4	-	-
Nasopharynx	0.4	0.3	0.8	0.7	0.5	-	5.5	1.2	3.5	3.5	4.0	4.7	3.1	2.8	4.1	1.8
Hypopharynx	11.0	0.9	22.3	5.4	6.7	2.0	3.4	0.8	10.3	0.6	21.5	0.4	4.0	0.7	2.0	1.6
Pharynx	1.6	0.1	3.3	0.8	1.0	0.7	0.5	-	1.4	0.9	1.4	-	1.1	1.5	0.3	-
Thyroid	0.2	0.7	0.4	2.4	0.8	1.1	0.9	4.8	1.8	2.5	3.0	3.3	1.0	2.0	1.1	1.1
Nasal sinus	0.4	0.1	0.9	0.5	-	-	0.5	0.2	1.1	0.9	2.2	1.0	0.6	0.8	0.3	0.6
Larynx	3.0	0.6	8.2	1.5	10.7	0.8	2.8	0.9	2.2	0.5	5.0	1.1	0.6	0.2	5.0	3.4

Source NCRP (2006) ; DIB : Dibrugah District, KUD: Kamrup Urban District, SIT : Silchar Town, IMP : Imphal West District,

MIZ : Mizoram State, AIZ : Aizawl District, MIO : Mizoram State (excl. Aizawl), SKM : Sikkim State

National and International Comparisons highlight some interesting findings not known earlier in relation to head & neck cancers with special reference to selected sites.

Figure 1. International Comparisons-AAR (Tongue)-C01-02

Location	Rate
Kamrup	12.2
Bhopal	8.8
Silchar	8.3
France	8.0
Delhi	6.0
Mumbai	5.7
Chennai	5.1
Dibrugarh	4.7
Bangalore	3.5
Aizawl	3.4
Singapore, Indian	2.8
Imphal	2.7
US SEER	2.5
Barshi	2.2
Sikkim	2.1
UK	1.2

Rate per 100,000 Males

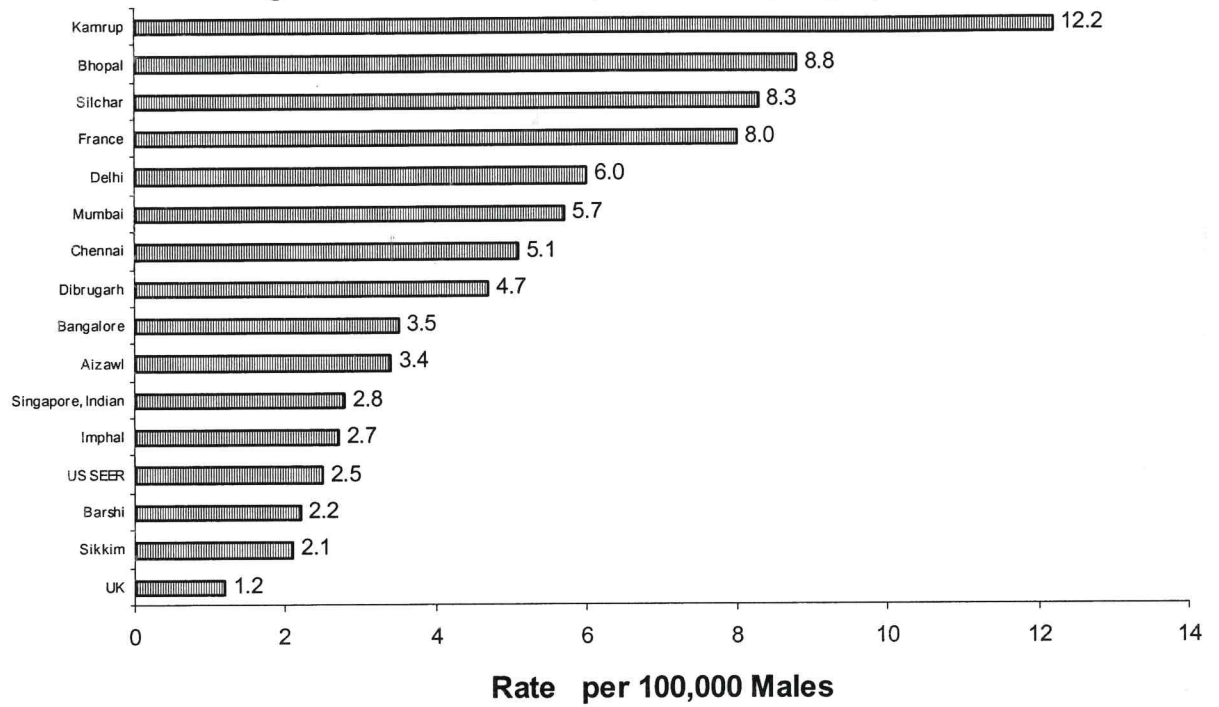### Figure 2. International Comparisons-AAR (Oral Cavity)-C03-06

Location	Rate
France	12.4
Kamrup	8.7
Bhopal	7.3
Chennai	6.4
Aizawl	6.3
Dibrugarh	6.3
Mumbai	5.7
Silchar	5.4
Delhi	4.1
Singapore, Indian	3.7
US SEER	3.0
Bangalore	2.7
Barshi	2.4
Imphal	1.8
Sikkim	1.3
UK	1.1

Rate per 100,000 Males
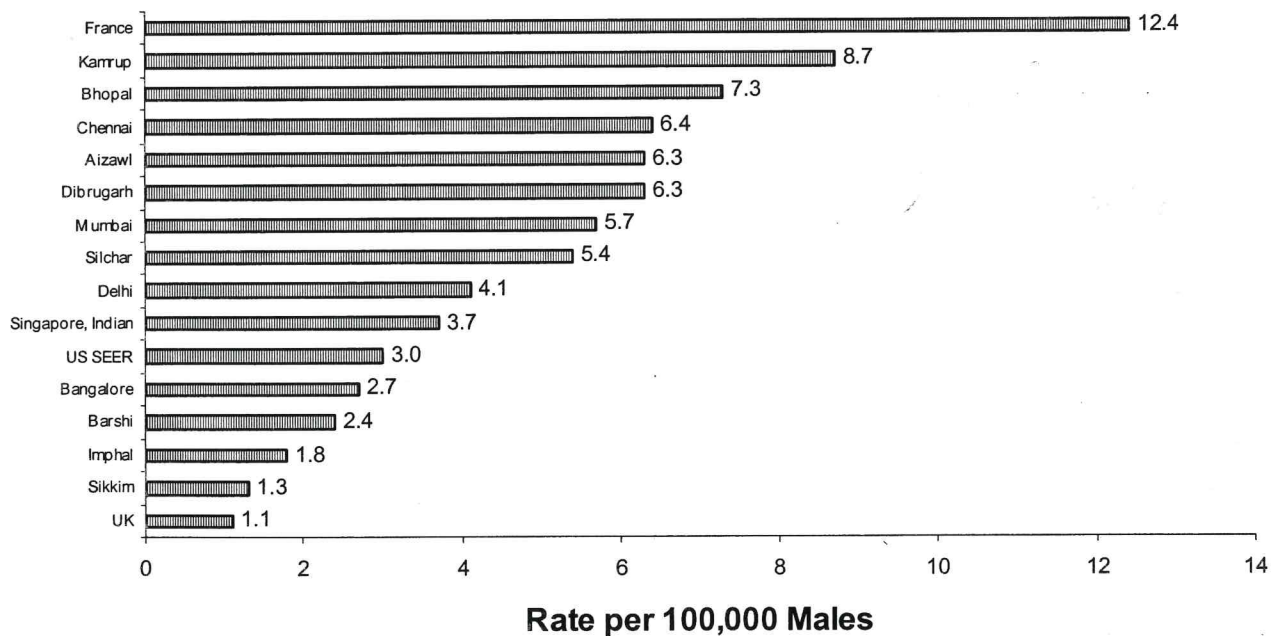
Figure 3. International Comparisons-AAR (Hypopharynx)-C12-C13)

Location	Rate
Kamrup	22.3
Aizawl	21.5
France	15.0
Dibrugarh	11.0
Bhopal	7.3
Silchar	6.7
Mumbai	6.3
Bangalore	5.8
Barshi	5.2
Chennai	5.1
Imphal	3.4
Delhi	2.8
Sikkim	2.0
Singapore, Indian	1.4
U.S., SEER	1.3
UK	0.5

Rate per 100,000 Males
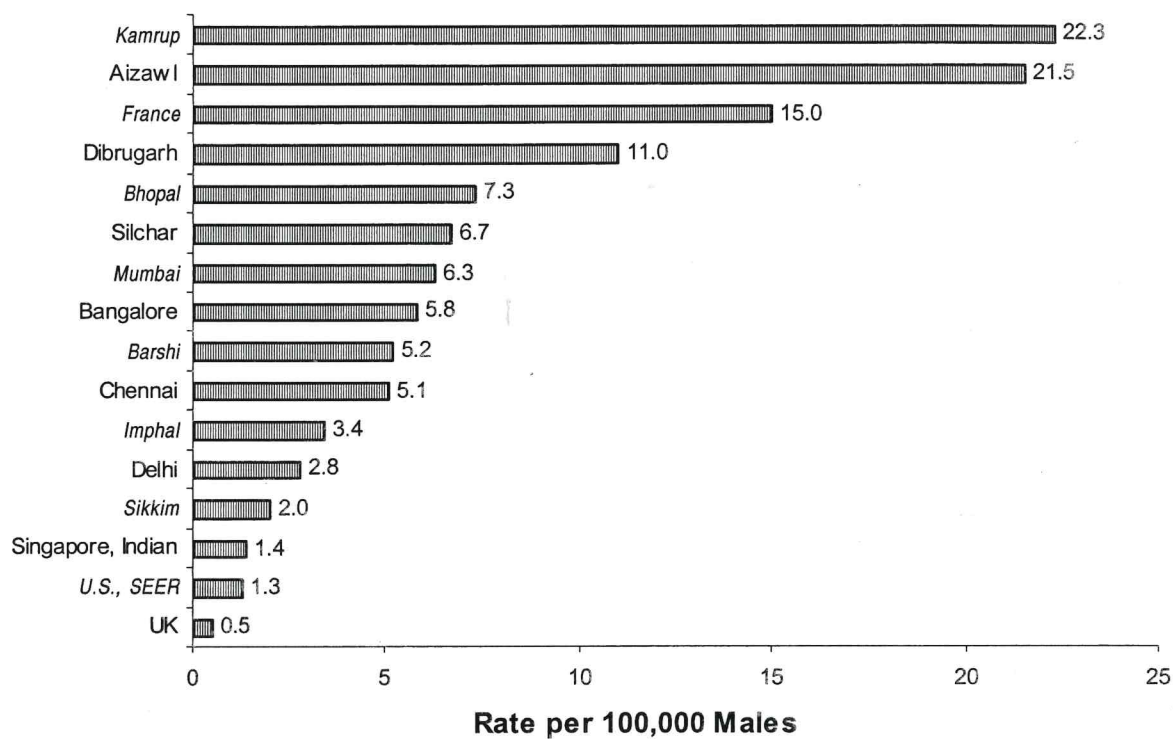
Figure 4. Comparisons-AAR (Larynx)-C32

Location	Rate
Silchar	10.7
Delhi	9.3
Kamrup	8.2
Mumbai	6.9
Sikkim	5.0
Aizwal	5.0
Chennai	4.4
Singapore, Indian	4.3
Bangalore	4.2
Bhopal	3.9
UK	3.4
U.S. SEER	3.3
Imphal	2.8
Dibrugarh	2.4
Barshi	2.3

Rate per 100,000 Males

23
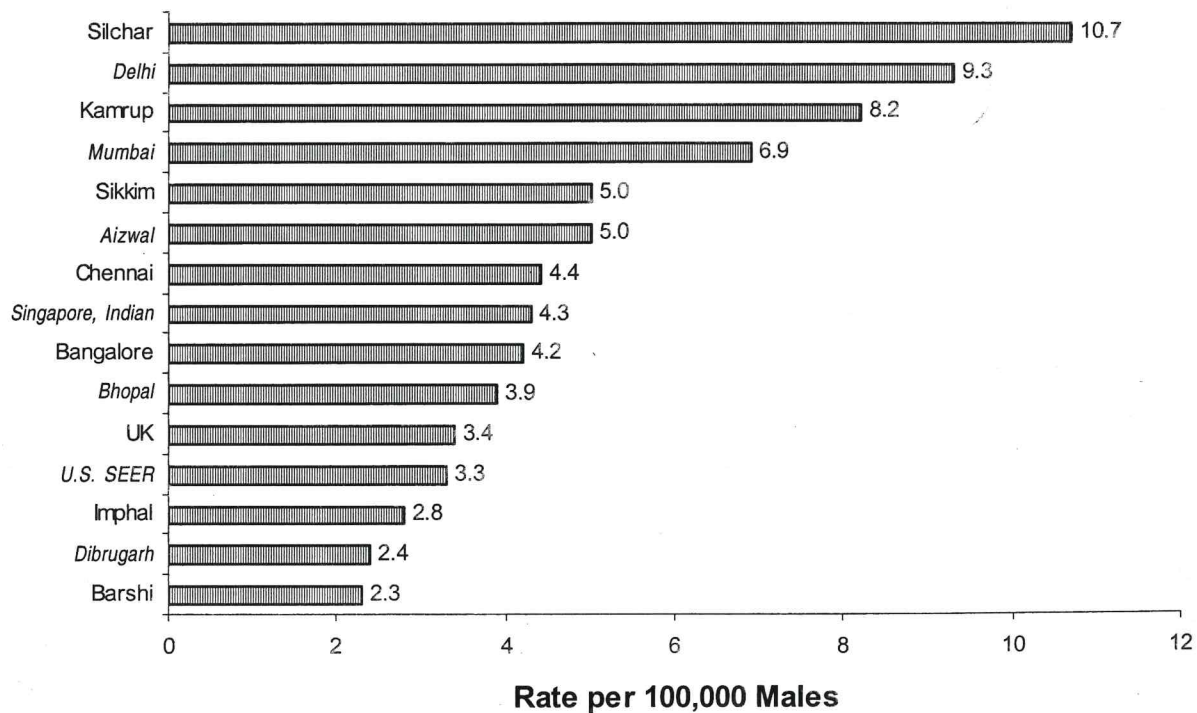
Etiological factors (already known / well studied / in progress)

Etiological factors include viruses, deficient diet, carcinogens, familial and molecular epidemiological factors.

Principal carcinogens for squamous cell carcinoma of head & neck (HNSCC)

Principal carcinogens include smoking, alcohol, chewing tobacco (betel nut), nickel and chromates dust for cancers in nose, larynx, lung and PNS, hardwood dust for adeno carcinoma of PNS, nitrosamines in salted fish diet for NPC.

Protective role of diet rich in vegetables & fruits (20- 60% reduction in risk) is emphasized.

Virus – HPV and EBV are associated with head & neck cancer. HPV prevalence ranges from 8- 100% and 100% prevalence of HPV in verrucous carcinoma of larynx. Oropharynx tumours (tonsillar) are 3 times more likely to be HPV (+ve) than other head & neck sites. EBV is associated with NPC (not found in normal epithelial cells, but in tumour cells, even in dysplastic precursor cells). A strong genetic component is evident as increased risk of NPC is seen in migrants and children from Chinese or North African origin. A susceptibility gene near HLA- locus is associated with 20 fold risk of NPC (Singapore).

Cytogenetic abnormalities in HNSCC.

Frequent complex karyo types reported include gain or loss of y-chromosome and other. In oral cancer, activation of proto oncogene such as cyclin D1, myc, RAS, EGFR, inactivation of tumour suppressor genes such as p53 and p16 are reported. Early changes include loss of tumour suppressor genes such as 13p and 9p, followed by 17p. P53 mutations and over expression are seen in the progression of pre-invasive lesion to invasive lesion. P53 mutation is seen in 40-50% in developed and 5-25% in developing countries. Tumours from India & SEA is characterized by involvement of RAS oncogene in changing mutation of LOH (HRAS) and amplification (KRAS & NRAS) and genetic polymorphism in genes such as GSTMI & CYP450A1 (oral carcinogenesis).

Molecular genetics of head and neck cancer

An understanding of the genetic process underlying tumour initiation and progression has importance in therapeutic implication such as detection of known early genetic alteration in primary screening and early detection of tumour recurrence (Haemato-lymphoid & colorectal malignancy are good examples).

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TIME DELAY IN MANAGEMENT OF CANCER AFTER DIAGNOSIS REGIONAL CANCER CENTRE, THIRUVANANTHAPURAM

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Early diagnosis and treatment are the keys for successful management of cancer. This not only improves the survival but significantly reduces the morbidity of treatment, improves quality of life and most importantly reduces the financial constraints on the family and society. Generally a 'delay' is said to have occurred if there is a gap of more than one month between the onset of first symptom pertaining to cancer and the initiation of definitive treatment modality.

The purpose of this communication is to calculate the average time from the diagnosis of cancer to the initial treatment at the Regional Cancer Centre, Thiruvananthapuram and to assess the pattern of delay in the management of cancer according to age, sex, religion, education and various cancer sites.

The hospital based cancer registry (HBCR) of RCC, routinely collects date of first cancer diagnosis (first date on which a physician made a diagnosis of cancer, even if not confirmed histologically later or never confirmed), date of registration and the date of initial treatment at RCC. Patients registered at the HBCR of RCC during the year 2004 is used to calculate the time from the date of cancer diagnosis to the initial treatment for the present analysis. The average time along with standard error from diagnosis to treatment according to age, sex, religion, education and various cancer sites are calculated.

Results

The average time from the date of first cancer diagnosis to the initial treatment at RCC is more than one month in both sexes (Table 1). Patients who received partial cancer directed treatment (CDT) or those who have either not received or accepted any CDT at the RCC were excluded from the analysis. Overall, the delay is higher among males than females. The delay is highest among males in the age group of 15 - 34 years (average time is 52 days after the diagnosis for initial cancer directed treatment). Not much difference in time is observed according to education. Time delay is lowest among Christians in both sexes.

The time delay in management after diagnosis of cancer was more than 60 days for cancer sites such as bone (females) and soft & connective tissues (both sexes).The time delay was more than 40 days for cancer sites such as oral cavity (both sexes), salivary gland (both sexes), pharynx (females), oesophagus (females), stomach (males), bone (males), cervix uteri and brain & nervous system (both sexes) (Table 2).

The overall time delay from the diagnosis to the registration at RCC is more than 2 weeks in both sexes. The delay is highest among males in the age group of 15 - 34 years (Table 3).

The time delay in reporting to RCC after diagnosis of cancer was more than 20 days for cancer sites such as salivary gland (males), pharynx (females), stomach (males), bone & soft tissue (both sexes), brain & nervous system (males), thyroid gland (females), lymphoma (females) and leukaemia (males) (Table 4).

Discussion

In the present analysis, it was observed that the overall delay was higher among males particularly in the age group of 15-34 years. Majority of males in the age group of 15-34 years are working class people. It is possible they might have ignored the severity of the disease as cancers in the early stages are painless. Not much difference in time delay was observed by education and religion of the patients. Many cancers though diagnosed early, the time span to reporting for treatment is delayed for more than 45 days. By this time the stage at diagnosis could change to higher stages.

'Delay' is said to have occurred if there is a gap of more than one month between the time from the 'date of symptom' to the 'initial treatment'. In the present analysis, we have looked into the time delay from the date of diagnosis to the initial treatment as date of first symptom was not available in the cancer registry data base. Jayalakshmy et al. in 1989, have looked into time delay from the first symptom to diagnosis. It was observed that the time delay from the first symptom to diagnosis was more than 3 months in 75% of cancer patients reported to RCC (n = 97). Thus generally a cancer patient makes a total of 4 - 5 months time dealy from the onset of symptom to the initiation of cancer directed treatment.

Conslusion : In order to reduce the time delay in treatment after diagnosis of cancer, it is very important to educate the public from all walks of life, the need for immediate reporting to a cancer hospital.

Reference

Jayalekshmy P, Latha P.T, Nair M.K and Padmanabhan T.K. HCR social investigators search for causes of cancer diagnosis dealy. In Cancer Registry Abstract, News letter of the National Cancer Registry Programme of India. Vol III. No.2, 1989.

Table 1. Average time (in days) from the date of cancer diagnosis to the initial treatment at RCC, Thiruvananthapuram (previously treated patients excluded) (year : 2004)

	male (n = 2629)		Female (n = 2003)	
All sites	42.6	(1.5)*	39.6	(1.4)
Age (years)				
0-14	26.0	(3.5)	21.7	(3.8)
15-34	51.8	(6.1)	39.8	(3.9)
35-64	42.4	(1.6)	41.3	(2.0)
65+	43.1	(3.7)	39.1	(2.6)
Religion				
Hindu	44.6	(2.2)	41.1	(1.8)
Muslim	40.6	(3.0)	38.1	(3.3)
Christian	38.7	(2.2)	35.8	(3.1)
Education				
<5 years	32.0	(7.6)	16.9	(2.1)
Illiterate	45.6	(3.1)	47.7	(4.6)
Primary	43.4	(3.6)	39.4	(2.3)
Middle	40.3	(2.4)	40.4	(2.9)
Secondary	41.8	(2.5)	37.5	(2.7)
College & Technical	43.2	(4.9)	31.7	(3.3)
Others & Unknown	45.6	(9.0)	42.0	(8.0)

* Standard error

Tabel 2. Average time (in days) from the date of cancer diagnosis to the initial treatment for cancer sites at RCC, Thiruvananthapuram (previously treated patients excluded) (year : 2004)

Site (ICD - 10)	Male		Female	
Oral Cavity (C00 - C06)	44.7	(2.1)*	49.7	(4.2)
Salivary Gland (C07 - C08)	48.6	(15.6)	44.3	(5.1)
Pharynx (C09 - C14)	39.3	(3.5)	42.2	(6.8)
Oesophagus (C15)	38.9	(3.1)	42.1	(5.0)
Stomach (C16)	47.6	(7.5)	31.2	(3.0)
Lung (C33 - C34)	32.3	(2.3)	31.4	(4.8)
Bone (C40 - C41)	42.1	(5.8)	60.2	(21.5)
Soft Tissue (C47, C49)	74.2	(18.0)	66.4	(18.6)
Female Breast (C50)			31.4	(2.3)
Cervix Uteri (C53)			42.5	(3.9)
Ovary (C56)			31.6	(6.7)
Brain & Nervous System (C71 - C72)	50.2	(11.0)	41.1	(4.9)
Thyroid Gland (C73)	62.4	(16.7)	77.5	(19.6)
Lymphoma (C81 - C85, C96)	42.6	(1.5)	39.6	(1.4)
Leukaemia (C91-95)	38.4	(6.6)	20.6	(2.3)

* Standard error

Table 3. Average time (in days) from the date of cancer diagnosis to the date of registration at RCC, Thiruvananthapuram (previously treated patients excluded) (year : 2004)

	male (n = 2629)		Female (n = 2003)	
All sites	17.4	(1.4)	15.6	(1.3)
Age (years)				
0-14	12.0	(2.9)	9.3	(3.4)
15-34	26.4	(5.5)	18.1	(3.3)
35-64	15.8	(1.4)	16.7	(1.8)
65+	18.6	(3.5)	13.5	(2.7)
Religion				
Hindu	18.9	(2.1)	16.6	(1.7)
Muslim	17.0	(2.9)	13.7	(3.3)
Christian	13.4	(1.4)	14.1	(2.8)
Education				
<5 years	17.1	(6.7)	5.2	(0.9)
Illiterate	14.5	(2.8)	19.9	(4.5)
Primary	18.4	(3.5)	14.8	(2.0)
Middle	15.0	(1.5)	15.7	(2.4)
Secondary	17.1	(2.1)	13.6	(1.8)
College & Technical	20.4	(4.6)	16.1	(3.1)
Others & Unknown	24.4	(8.6)	15.0	(9.6)

*Standard error

Table 4. Average time (in days) from the date of diagnosis to the registration date at RCC for cancer sites (previous treated patients excluded) (year : 2004)

Site (ICD - 10)	Male		Female	
Oral Cavity (C00-06)	13.0	(1.9)*	18.4	(3.7)
Salivary Gland (C07-08)	26.7	(15.2)	17.0	(4.7)
Pharynx (C09-14)	15.9	(2.4)	21.7	(6.1)
Oesophagus (C15)	14.2	(2.8)	12.4	(2.1)
Stomach (C16)	24.9	(6.8)	11.3	(1.8)
Lung (C33 - C34)	11.4	(1.3)	11.1	(2.3)
Bone (C40-41)	17.3	(3.5)	28.7	(20.7)
Soft Tissue (C47, 49)	21.7	(11.2)	26.0	(12.7)
Female Breast (C50)			10.9	(2.4)
Cervix Uteri (C53)			16.2	(3.7)
Ovary (C56)			11.8	(2.7)
Brain & Nervous System				
(C71 - C72)	27.2	(10.5)	17.7	(2.7)
Thyroid Gland (C73)	10.9	(21.8)	38.8	(22.0)
Lymphoma (C81-C85, C96)	18.6	(2.6)	21.5	(5.5)
Leukaemia (C91-95)	21.3	(6.1)	8.4	(1.7)

*Standard error

TIME TREND IN THYROID CANCER PATIENT REGISTRATION (1982-2005) REGIONAL CANCER CENTRE, THIRUVANANTHAPURAM

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Introduction

Regional Cancer Centre (RCC), Thiruvananthapuram, a state of the art super specialty hospital was established in 1981. Currently more than 10,000 new patients, with 95,000 follow-up visits and more than 2,00,000 non-cancer patients report to the centre for various investigations and treatment annually. Since 1982, the Hospital Based Cancer Registry (HBCR) of RCC has been recording increasing number of cancer cases and in 2005, this is around 195% more than in 1982. The Centre caters to patients from all over the state of Kerala (around 90%), the neighbouring states of Tamil Nadu and Karnataka and also from neighboring countries. The Centre has an in-patient bed strength of 360. During the last five years, there has been more than 25% increase in the registration of both cancer and non-cancer patients.

Around 600 thyroid cancers (TC) are seen at the RCC, Thiruvananthapuram annually. Currently at RCC, TC is the 10th leading cancer site among males and the 3rd leading cancer site among females. Since the inception of HBCR in 1982, it has been recording increasing number of thyroid cancer cases, and in 2005 (after 24 years), this is 680% more than in 1982.

The present communication analyses the overall time trend (1982 to 2005) in thyroid cancer patient registration at the HBCR of RCC and their pattern according to age and religion. For the present analysis patients registered only at the RCC is included even though the HBCR included patients from the adjacent Thiruvananthapuram medical college hospitals till 1996.

Results

The number and relative proportion of thyroid cancers over the years (1982 to 2005) is given in Table 1 and in Figure 1. The nature of data (proportional increase of thyroid cancer) showed a linear relationship between the year and the relative proportion of thyroid cancer patient registration at RCC in both sexes. Hence a linear trend is fitted to the data. The regression coefficients were 0.09 for males and 0.35 for females (y=0.0865x + 170.37 for males and y=0.349x + 689.24 for females). The proportional increase was noted higher among females. The proportion of thyroid cancer in males was 1.34 in 1982 and 3.0 in 2005 whereas the corresponding proportion in females was 3.4 in 1982 and 10.0 in 2005. The female to male ratio of TC over time is given in Table 2. The female to male ratio is 3.0:1 in 2005 whereas in 1982, the corresponding ratio was 2.0:1.

Table 1. Number and relative proportion of thyroid cancers (1982-2005) Regional Cancer Centre, Thiruvananthapuram

Year	Male			Female		
	Thyroid cancer	Total	%	Thyroid cancer	Total	%
1982	21	1567	1.34	48	1400	3.43
1983	23	1673	1.37	41	1449	2.83
1984	30	1885	1.59	67	1632	4.11
1985	29	1892	1.53	67	1669	4.01
1986	20	2117	0.94	58	1862	3.11
1987	35	2280	1.54	70	1959	3.57
1988	37	2415	1.53	75	2081	3.60
1989	46	2547	1.81	90	2180	4.13
1990	50	2547	1.96	97	2183	4.44
1991	60	3061	1.96	153	2706	5.65
1992	60	3189	1.88	174	2850	6.11
1993	75	3217	2.33	189	2712	6.97
1994	61	3277	1.86	193	2976	6.49
1995	52	3528	1.47	217	3148	6.89
1996	95	3765	2.52	278	3265	8.51
1997	92	3918	2.35	265	3446	7.69
1998	102	4037	2.53	306	3647	8.39
1999	105	4075	2.58	310	3728	8.32
2000	109	4157	2.62	327	3879	8.43
2001	134	4566	2.93	338	3973	8.51
2002	133	4655	2.86	395	4252	9.29
2003	155	4577	3.39	447	4147	10.78
2004	153	4708	3.25	455	4145	10.98
2005	135	4557	2.96	404	4207	9.60

Figure 1. Time trend in proportion of thyroid cancer patient registration
Regional Cancer Centre, Thiruvananthapuram (1982-2005)
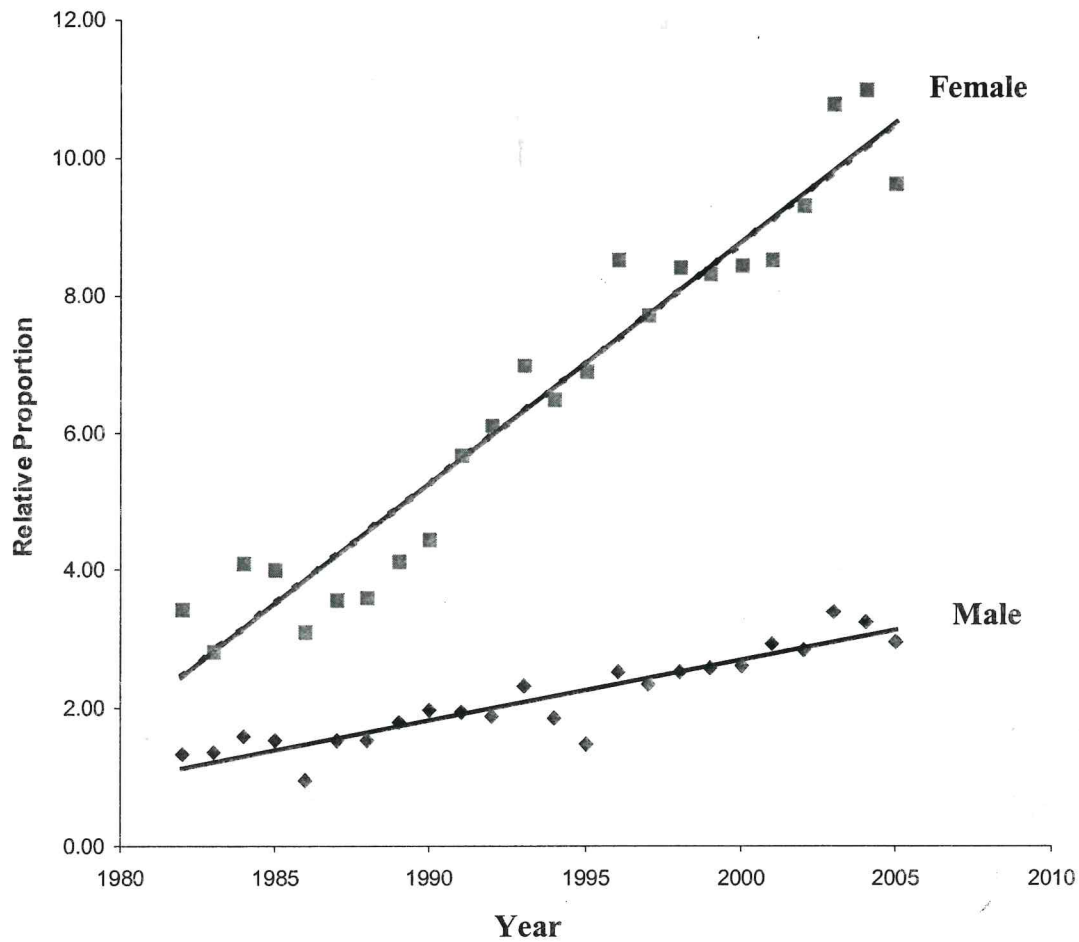
Average age at diagnosis over time in both sexes in given in Table 3. No difference in the average age at diagnosis was seen in both sexes.

Relative proportion of TC according to religion over time is given in Table 4. The proportional increase in thyroid caner patient registration at RCC is not different religionwise.

Table 2. Female to male ratio of thyroid cancer patient registration Regional Cancer Centre, Thiruvananthapuram (1982-2005)

| Year	Female	Male	Ratio
1982	48	21	2.3:1
1983	41	23	1.8:1
1984	67	30	2.2:1
1985	67	29	2.3:1
1986	58	20	2.9:1
1987	70	35	2.0:1
1988	75	37	2.0:1
1989	90	46	2.0:1
1990	97	50	1.9:1
1991	153	60	2.6:1
1992	174	60	2.9:1
1993	189	75	2.5:1
1994	193	61	3.2:1
1995	217	52	4.2:1
1996	278	95	2.9:1
1997	265	92	2.9:1
1998	306	102	3.0:1
1999	310	105	3.0:1
2000	327	109	3.0:1
2001	338	134	2.5:1
2002	395	133	3.0:1
2003	447	155	2.9:1
2004	455	153	3.0:1
2005	404	135	3.0:1

Table 3. Mean age and standard error of thyroid cancer patient registration Regional Cancer Centre, Thiruvananthapuram (1982-2005)

| Year	Male		Female	
	Mean age	Std. Error	Mean age	Std. Error
1982	56.24	3.62	44.67	2.29
1983	50.78	2.94	40.83	2.52
1984	54.30	3.13	44.70	2.16
1985	48.52	2.93	41.28	1.96
1986	51.80	3.91	43.10	2.14
1987	52.20	2.75	40.79	1.98
1988	50.14	3.18	47.32	2.04
1989	51.20	2.67	40.30	1.75
1990	46.72	1.98	43.72	1.43
1991	47.63	2.15	40.21	1.22
1992	41.37	1.89	39.41	1.13
1993	44.43	1.78	40.95	1.17
1994	46.13	2.25	39.10	1.13
1995	45.79	2.47	39.58	1.05
1996	46.47	1.86	38.90	0.85
1997	44.18	1.71	38.45	0.84
1998	45.12	1.77	38.65	0.79
1999	49.22	1.50	40.91	0.87
2000	42.83	1.50	38.02	0.81
2001	46.63	1.36	38.75	0.79
2002	46.82	1.40	39.79	0.73
2003	43.34	1.31	39.94	0.69
2004	44.94	1.28	41.34	0.68
2005	44.76	1.29	40.59	0.68

Table 4. Time trend by religion in proportion of thyroid cancer patient registration
Regional Cancer Centre, Thiruvananthapuram (1982-2005)

Year	Hindu		Muslim		Christian	
	Male	Female	Male	Female	Male	Female
1982	1.22	2.92	2.06	2.63	1.30	5.48
1983	1.29	2.43	2.17	3.38	1.26	3.83
1984	1.59	2.87	0.00	5.66	2.33	6.89
1985	1.60	3.09	1.18	5.03	1.55	6.38
1986	0.90	2.82	1.09	3.24	1.00	3.94
1987	1.91	3.34	1.39	4.40	0.57	3.98
1988	1.53	2.80	1.64	4.39	1.47	5.82
1989	1.55	3.91	3.25	5.00	1.69	4.35
1990	1.74	4.01	2.23	4.80	2.40	5.50
1991	1.77	4.53	3.60	9.97	1.36	6.67
1992	1.53	5.55	2.33	7.56	2.50	6.89
1993	2.17	6.21	3.00	8.75	2.30	8.28
1994	1.51	6.16	2.28	8.36	2.47	6.39
1995	1.59	6.58	1.28	8.44	1.30	6.96
1996	2.55	7.36	1.97	10.99	2.94	10.28
1997	2.12	6.97	2.22	8.32	3.05	9.36
1998	2.61	8.23	1.69	8.02	2.98	9.07
1999	2.70	7.58	2.85	10.42	2.04	8.96
2000	2.70	7.95	2.49	9.64	2.50	8.89
2001	2.74	8.01	4.05	10.15	2.50	8.85
2002	2.78	8.76	2.72	14.20	3.19	7.46
2003	3.13	9.39	4.51	14.16	3.16	12.34
2004	2.83	10.14	4.81	12.46	2.91	12.23
2005	2.68	8.94	3.72	9.65	3.06	11.31

Figure 2. Time trend by religion in proportion of thyroid cancer patient registration Regional Cancer Centre, Thiruvananthapuram (1982-2005) (Male)
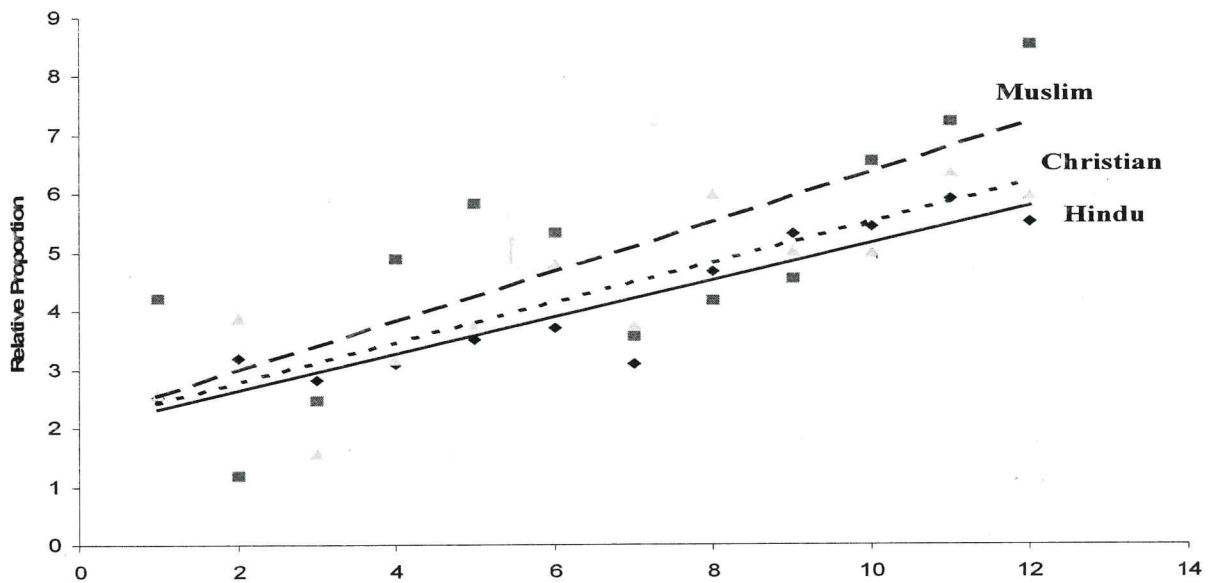
Figure 3. Time trend by religion in proportion of thyroid cancer patient registration Regional Cancer Centre, Thiruvananthapuram (1982-2005)(Female)
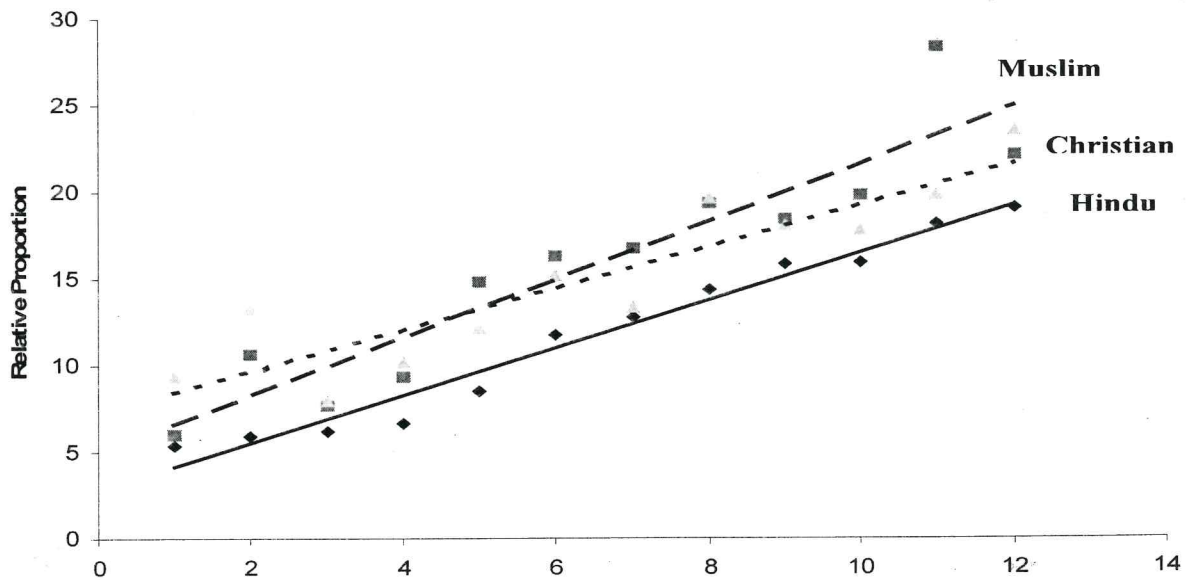
Discussion

Thyroid cancer (TC) is recognized as an infrequent disease worldwide. The female preponderance of TC is seen universally. In Kerala, thyroid cancer incidence is higher than any other population in India. In the present analysis, it is observed that there is a linear increase in the proportion of thyroid cancer patient registration at RCC in both sexes and this proportional increase is quite high among females irrespective of the religion such as Hindu, Muslim and Christian.

Although RCC has been diagnosing and treating thyroid diseases since 1983, the radio iodine (^{131}I) treatment has been started in late 1990's. Due to the availability of nuclear medicine facilities, a large number of patients with thyroid diseases are referred to RCC for investigations and treatment. A number of TC patients who had treatment elsewhere also attend RCC for review. Hence the increase is at least partly due to improved diagnostic services and availability of ^{131}I therapy at RCC. However, the increasing number of thyroid cancer patients is noted since the inception of HBCR at RCC. Secondly the proportional increase is not similar in both sexes. Hence it seems likely that the rising proportional increase of TC is due to an increased prevalence of risk factors particularly among females and to improvements in diagnosis as well as, treatment facilities at RCC.

Hospital based data always shows selection bias. In order to remove the selection bias (referral bias), population-based data is needed. In Kerala, the incidence data since 1991 are available from the two population-based cancer registries in Thiruvananthapuram and Karunagappally taluks in Kerala functioning by the RCC. These data should be utilized to study the time-trend in incidence rates in order to remove the referral bias.

In conclusion, the relative proportion of thyroid cancer patient registration at RCC has increased in both sexes and substantially in females. To some extent, the trends may be explained by increase in the detection of TC due to improvements in diagnosis, partly due to some increasing prevalence of risk factors (to be identified) and to some extent due to improved in treatment facilities at RCC.

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PREVALENCE OF TOBACCO USE IN BARSHI RURAL CANCER REGISTRY POPULATION

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Barshi rural cancer registry was set up in 1987 and covered about 0.4 million population in 3 sub districts of Barshi. An innovative methodology in which cases were registered by interacting with the community was adopted to overcome the prevailing obstacles for cancer registration in rural areas.

Table 1. Age Adjusted Cancer Incidence Rates (per 100,000 populations) in Barshi and other cancer registries in Maharashtra

Gender	Barshi 1990-96	Pune 1990-96	Mumbai 1996-2000	Nagpur 1995-99
Male	46.2	115.4	99.3	105.7
Female	57.5	119.1	112.2	107.8

The comparison shows that the cancer incidence rates in Barshi are low compared to the rates in Mumbai and other registries in Maharashtra.

Table 2. Age-adjusted incidence rates of tobacco-related cancers in Barshi and other registries in Maharashtra

	Barshi (1990-96)	Pune (1990-96)	Mumbai (1996-2000)	Nagpur (1995-99)
Smoking and chewing dependent cancers Oral cavity, Pharynx (excluding nasopharynx) & Esophagus	15.9	31.0	24.8	30.5
Smoking dependent cancers Larynx Lung	2.3 1.6	6.9 12.0	7.4 6.9	9.3 7.3
All other sites	26.4	65.5	60.2	58.6

Tobacco related cancers [oral cavity, pharynx (excluding nasopharynx), esophagus, larynx and lung] as well as other cancers have a low incidence rates in Barshi as compared to the other registries in Maharashtra.

One of the reasons for the low incidence rates of cancers other than tobacco related in males is perhaps due to under registration of cases of internal cancers. It has been shown that the registry is not likely to have missed any diagnosed case. However, the possibility of cancer cases not being diagnosed due to patients not seeking medical attention or seeking it too late and dying before diagnosis is established cannot be ruled out. This possibility is clearly greater for internal cancers.

To explain the low rates of tobacco related cancers (TRC) in Barshi, it was necessary to assess the prevalence of tobacco use in the population. Therefore a tobacco survey was undertaken in 1994-95. The results are provided below.

A simple random sample of villages from the 3 Tehsils such as Barshi, Paranda and Bhum (Table 3) was drawn to cover about 3 % of the population of the Barshi register. Variation in the percentage of population in the 3 tehsils is because of varying sizes of the population of the villages sampled. Entire village was considered as the unit of sampling. House to house visits in the sampled villages were undertaken and all the individuals were enrolled. Those above 14 years were interviewed for their tobacco habits as per the predesigned proforma provided by the NCRP.

Table 3. Sample size

Tehsil	Total Villages	1991 population	Village Sampled	Population	%
Barshi	134	212471	3	7339	3.5
Paranda	117	124673	3	4582	3.7
Bhum	95	108067	3	2642	2.4
Total	346	445211	9	14563	3.3

Table 4. Enrolled and interviewed population size

	Male	Female
Enrolled Population (14+)	5319	4936
Interviewed population	4384	4309
%	82%	87%

Table 5. Prevalence of Tobacco Habits

	Male		Female	
	N	%	N	%
Smoking only				
Bidi	58	1.3	13	0.3
Cigarette	20	0.5	1	0.0
Bidi+Cigarette	2	0.1	0	0.0
Chewing only				
Tobacco	1960	44.7	218	5.1
Mishri	23	0.5	206	4.8
Tobacco+Mishri	127	2.9	52	1.2
Smoking & Chewing	155	**3.5**	5	0.1
Non users	2309	**46.5**	3814	**88.5**
Total	4384	100	4309	100
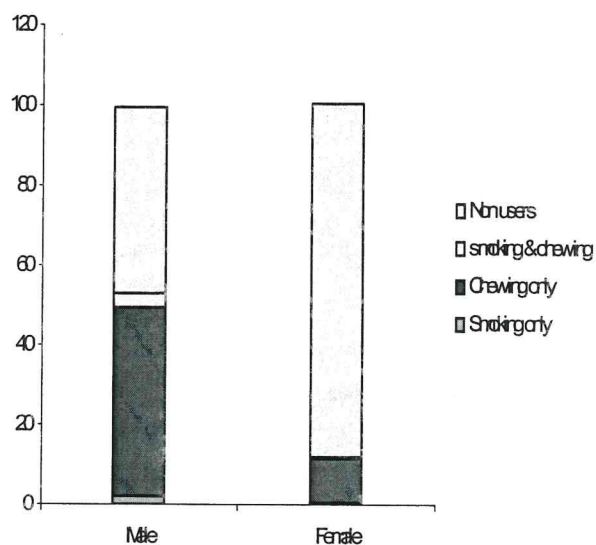
Table 6. Prevalence of chewing and smoking in Barshi and other areas

	Areas where oral cancer incidence is high		Barshi	
Habits	Male	Female	Male	Female
Prevalence of Chewing	11%-55%	10%-39%	51.1%	6.4%
Prevalence of Smoking	8%-77%	2%-12%	5.4%	0.4%

Comparing the prevalence of tobacco habits in Barshi with the reported percentages in areas where oral cancer incidence was high shows that in males the prevalence of chewing is not too low but prevalence of smoking is indeed much lower than that reported elsewhere.

It would be of greater interest to compare the incidence of TRC in Barshi to that of another registry where data on both the incidence and tobacco prevalence are available. For Mumbai, such data is available but the prevalence is given for those above 35 years (P.C. Gupta). Comparative figures for males are given below.

Table 7. Cumulative risk of smoking dependent cancers in Barshi and Mumbai

Site	Cumulative risks (0-64 years) 1988-92	
	Barshi	Mumbai
Oropharynx	0.03	0.20
Larynx	0.09	0.48
Lung	0.09	0.83

Prevalence of smoking and chewing in Mumbai and Barshi
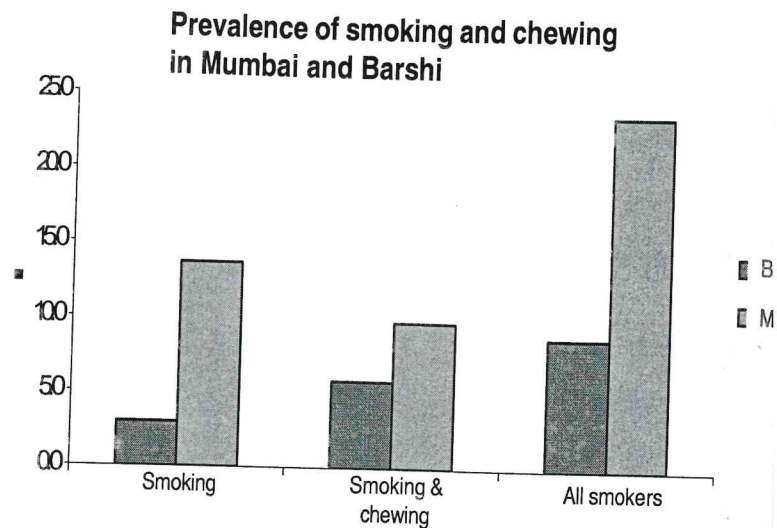
Smoking percentage is much lower in Barshi compared to Mumbai. This explains the low cumulative risk predominantly in smoking dependent cancers like cancers of oropharynx, larynx and lung (Table 7).

Site	Cumulative risks (0-64 yeras) 1988-92	
	Barshi	Mumbai
Lip	0.02	0.02
Tongue	0.17	0.40
Mouth	0.23	0.44
Hypopharynx	0.36	0.52
Esophagus	0.37	0.57

Prevalence of smokless tobacco in Mumbai and Barshi
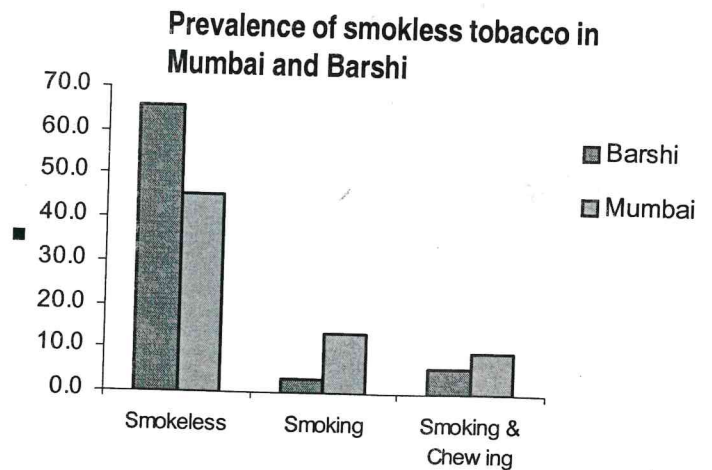
Despite proportion of chewers among males in Barshi, being higher than that in Mumbai, cancer sites such as tongue and mouth have lower cumulative risks. Interestingly, the risk of mouth cancer is only half of that observed in Mumbai, whereas cancers of hypopharynx and esophagus have two thirds the risk observed in Mumbai.

Table 9. Relative risk of single & dual habits in comparison with non-smokers & non-chewers

Site	Habits		
	Chewers Only	Smokers Only	Chewers & Smokers
Oral Cavity	5.98	2.82	10.14
Oropharynx	3.30	11.83	31.72
Hypopharynx	6.21	3.62	16.86
Larynx	4.58	7.74	20.09
Esophagus	2.54	2.17	6.15
Jassawalla D.J. & Deshpande			

It is observed that the dual habit persons have a higher risk than those with single habits. The lower risks of the above cancers in Barshi can perhaps be explained as due to lower proportion of males with dual habit as well as smokers, as it is known that the dual habit has a synergistic effect. For elucidating these differences one also needs to study among chewers the frequency, ingredients used and the age of addiction.
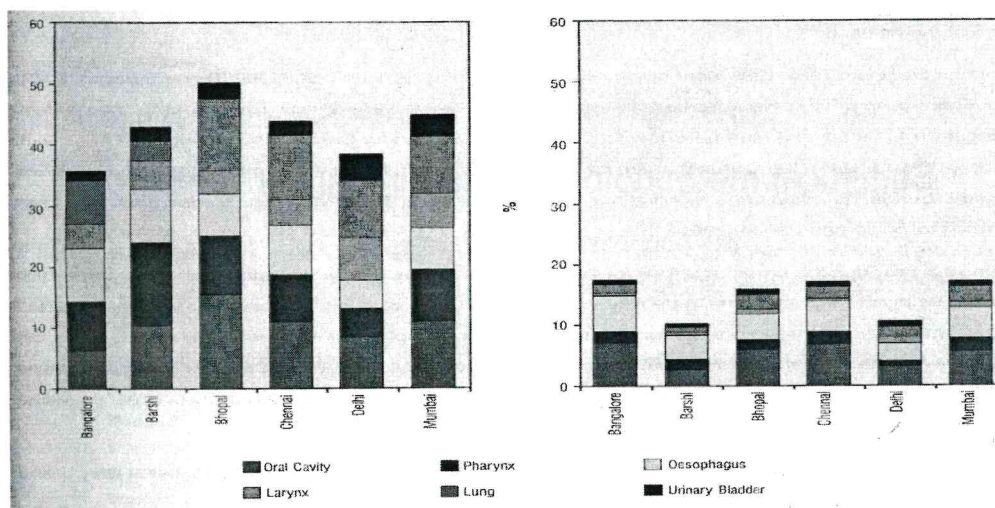
This is a preliminary effort to explain the low rates of tobacco dependent cancers in Barshi Registry.

More detailed study is needed to assess the current habits to see whether there are any changes in the habit pattern in the last decade, particularly with regard to age of start of the habit. There is also a need to educate the population on hazards of tobacco habits so that younger people do not take up the habit.

Acknowledgment

Section II

Statistical methodologies used in cancer registries

DESCRIPTIVE STUDIES

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Epidemiological studies can be broadly divided into three sections:
1. Descriptive
2. Analytical or Aetiological
3. Experimental or Interventional

Analytical or aetiological studies are concerned with estimation of relative risks of certain exposure factors to the development of disease, disability or death. These studies can be prospective (cohort) or retrospective (case-control) or both.

Experimental studies measure the effects or efficacy of specific interventions on persons with disease (clinical trials) or in susceptible persons to prevent disease (prophylactic).

Descriptive studies often lay the foundations for the analytical or experimental epidemiology. These studies include :
1. Determining the interactions among Host (usually human), Agent (parasites, bacteria, virus, carcinogens, etc) and the Environment (Physical, Social, Cultural, etc), traditionally known as the "Epidemiological" Triad.
2. Documenting and describing time trends (Temporal relationships)
3. Determining geographical variations (Spatial relationships)
4. Estimating Prevalence, Incidence and Duration of disease
5. Describing transmission rates, possible portals of entry and exit
6. Calculating various epidemiological indicators by demographic and socioeconomic factors.

As the label indicates, Descriptive Studies are meant to describe the current scenario using the best possible study designs, statistical analyses and formulate cogent hypotheses for further testing.

These studies are relatively easy to carry out, but one should ensure that all the basic requirements of a scientific study are fulfilled. This will include a good literature search to identify similar studies done in the past and lessons learnt, formulating specific research objectives, designing an appropriate study plan with comparative groups, determining adequate sample sizes and handling nonresponses, developing reliable and valid tools for data collection, quality control and monitoring, efficient data management and use of correct statistical tools for determining confidence intervals or statistical significance and finally preparing the scientific presentation in line with the objectives of the study.

These are basic steps in any research and must not be glossed over as though descriptive studies are merely exploratory or pilot studies, and can be done superficially.

Descriptive studies can also provide some clues to etiology or effectiveness of health interventions, but the limitations should be kept in mind and also the possible biases arising out of several nonsampling errors (response, recall, non-response, measurement etc).

Much of the NCRP reports constitute the findings from descriptive epidemiological studies. Both the tables and the diagrams present the data in a concise and attractive manner. From these data, many ideas should arise for further specific descriptive studies and other epidemiological research.

STATISTICAL INFERENCE

Biostatistics is the science of dealing with the collection, analyses and interpretation of data arising out of studies on the humans or animals.

The science of interpretation is known as **Statistical Inference** which usually consists of :
   (a) Determining Confidence Intervals
   (b) Carrying out Statistical Tests of Significance

Since all our studies are based on samples, the process of generalizing from the sample to the population constitutes statistical inference. In logic, this is known as 'Inductive Inference', moving from the part to the whole. Such inference depends heavily on the science and measurement of probability.

The basis of statistical inference rests heavily on random samples or randomization, and thus it is convenient to use the laws of probability in the interpretation of results from a sample.

When random samples of a certain size are repeatedly chosen from the same population, using the same method, the sample statistics invariably follow a known probability distribution such as the Gaussian (Normal), Student's t, Fishers F, etc. The standard deviation of this sampling distribution, known as the standard error (SE), is then used as yardstick to measure the role of chance in the occurrence of a difference or association.

The tabled values of the assumed probability distribution are used to determine the 95% or the 99% or any other Confidence Interval (CI). Such confidence interval can ignore all other factors (crude) or take them into account (adjusted).

Likewise, in the test of statistical significance of a difference or association, the required level of significance (5% or 1% or less) can be determined using the Tables of Probability distributions.

These thresholds generally take care of only one type of errors (Type I or alpha), where we guard against rejecting a true null hypothesis. Ideally we should also guard against another type of error (Type 2 or beta), viz.,not rejecting a false null hypothesis. Appropriate cut-off points can be determined using the same probability distributions to take care of both type of errors at given levels.

When sample size is large, the inference is based using these probability distributions. On the other hand, if the sample size is small, such assumptions may not be valid, and an exact probability test, known as a Nonparametric statistical test should be used.

Several good statistical software for use in computers are now available to help in these calculations and interpretation of the sample data.

These details can be found in any standard text-book of Statistics or Biostatistics.
Several worked out examples are given in Chapter 12 of the book "Introduction to Biostatistics and Research Methods" (4th Edn; Prentice Hall) by Sundar Rao & Richard, and also in other chapters.

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BASIC STATISTICAL TERMS IN CANCER REGISTRIES

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The objective of the article is to focus on basic statistical terms and calculations, which are necessary for those who are involved in Cancer Registration, directly or indirectly. The terms which one comes across frequently, going through the various PBCR reports are:

1. Cancer Registration
2. Cancer Registry
3. Population Based Cancer Registry
4. Registry area
5. Population at risk
6. Cases
7. Crude Rate (C.R.)
8. Age Specific Rate
9. Age Adjusted Rate (A.A.R.)
10. Truncated Rate
11. Cumulative Rate
12. Cumulative Risk

Cancer Registration: It is a continuous process of systematic collection of data on the occurrence and characteristics of reportable neoplasm.

Cancer Registry: It is an office or system performing cancer registration.

Population Based Cancer Registry (PBCR): A cancer registry is involved in cancer registration from a well-defined geographical area.

Registry Area: PBCRs are registering cancer cases from a well-defined geographical area. Such an area is termed as registry area. It may be a district or town or may consist of a bunch of municipal wards. If the geographical area is not well defined then describing the magnitude of the cancer problem become difficult and bias may occur in reporting of the same.

Population at Risk: The population residing in the registry area is considered as population at risk of developing cancer.

Cases: An individual with certain disease condition or a health problem is called a case. In cancer registries, the individuals diagnosed with cancer are termed as cases.

Crude Rate: For a given year and for a given registry, it is defined as the ratio of number of cancer incidence cases during the year to the population at risk. Rate is measured in units of the reciprocal of time. The above

ratio is crude incidence rate per person years. For rare diseases like cancer, it is difficult to get an idea abo the magnitude of cancer from the above ratio. Hence we multiply by a suitable number such as 100,000 a rate is expressed per 100,000 person years. In terms of formula:

$$\text{Crude Rate (C.R.) per 100,000 person years} = \frac{\text{New cancer cases during the year}}{\text{Estimated mid year population}} \times 100{,}000 \quad \text{.......... (1)}$$

The C.R. may be calculated based on cancer cases for a period also. In that case the above formula may written as:

$$\text{Average Annual C.R per 100,000 years during the period} = \frac{\text{New cancer cases during the period}}{\text{Estimated person years for the period}} \times 100{,}000 \quad \text{........... (2)}$$

The term person years is estimated as the sum of mid-year populations for the given period. eg. F a given area, the number of cancer cases for the years 2001, 2002 & 2003 are 1860, 1940 & 2010 respective with corresponding mid-year population estimates as 29,40,770, 30,34,900 & 31,32,050 respectively. The figures are shown in Table 1.

Table 1: Calculation of C.R. for a period as well as for a single year

Year	2001	2002	2003	2001-2003
Cases	1860	1940	2010	5810
Mid year Population	29,40,770	30,34,900	31,32,050	91,07,720
C.R.	63.2	63.9	64.2	63.8

In above example, for calculating the C.R. for individual years, the formula (1) is used while for peri 2001-03 the formula (2) is used. Here 5810 refers to total number of cancer cases reported during the peri and 91,07,720 which is the sum of population for the three years and is termed as person years.

Age Specific Rate: Risk of cancer is known to increase with age. Hence, it is interesting to see the rates age. For a given year, it is defined as the ratio of number of cancer incidence cases for a given age grou during the year to the population at risk. In terms of formula:

$$\text{Age Specific Rate per 100,000 population} = \frac{\text{New cancer cases during the year for a given age group}}{\text{Estimated mid year population for the given age group}} \times 100{,}0$$

The age groups, which are considered normally, are: 0-4 years; 5-9 years; 10-14 years; 15-19 years,..., 70-74 years; 75 years & above. For calculation of Age Specific Rate, it is essential that we have the knowledge of number of cases and the population in each age group. As an example, the Age Specific Rates for all sites of a sample data in a PBCR area is shown in column 4 of Table 2.

Table 2: Calculation of Age Specific Rate and Age Adjusted Rate - All sites – Sample data

Age group (years) (1)	No. of cases (2)	Population at risk (3)	Age Specific Rate (As_pR) (4) ai	World Standard Population (5) wi	ai x wi (6)
0 - 4	13	264830	4.91[1]	12000	58905.71[2]
5-9	18	308984	5.83	10000	58255.44
10-14	22	297899	7.39	9000	66465.48
15 - 19	15	298640	5.02	9000	45204.93
20 - 24	31	328583	9.43	8000	75475.60
25 - 29	34	291619	11.66	8000	93272.39
30 - 34	37	244108	15.16	6000	90943.35
35 - 39	54	229568	23.52	6000	141134.65
40 - 44	86	172746	49.78	6000	298704.46
45 - 49	149	137648	108.25	6000	649482.74
50 - 54	199	102802	193.58	5000	967880.00
55 - 59	175	68117	256.91	4000	1027643.61
60 - 64	193	62829	307.18	4000	1228731.95
65 - 69	228	35829	636.36	3000	1909068.07
70 - 74	158	29243	540.30	2000	1080600.49
> = 75	222	32436	684.42	2000	1368849.43
Total	1636	2905881	56.30	100000	9160618.31
		C.R.	56.30	A.A.R.	91.61

[1] (13/264,830)*100,000 = 4.91; [2] 4.91*12000 = 58905.71

Age Adjusted Rate (A.A.R.) : Incidence or mortality rates for a particular cancer between two different populations or for the same population over the time is usually compared. Comparison of crude rates may not give the true reflection of the differences but may show the differences largely due to the difference in the age structure of the populations to be compared. It may be argued that in spite of age specific rates being same, a population with higher proportion of older population may give rise to a higher number of cases as compared

to a population with higher proportion of younger population. Further, most developed countries have a highe proportion of older population. So in order to make the rates of cancer comparable between ddifferer populations, it is essential that a common population structure may be used. Thus, a world standard populatic that takes this into account is used to calculate Age Adjusted Rate. The most frequently used is the Wor Standard Population modified by Doll et al (1966) from that proposed by Segi (1960). The world standar population approximates the proportional age distribution of the world and is shown in column 5 of Table 2. If a_i is the Age Specific Rate and W_i is the World Standard Population for the ith age group then the formula f calculation of Age Adjusted Rate can be given as follows:

$$A.A.R. = \frac{\Sigma\ a_i \times W_i}{\Sigma\ W_i} \quad \text{for } i = 1,2,3,....16 \quad \text{where } \Sigma\ W_i = 100,000$$

The numerator of the above formula has been calculated and shown in column 6 of Table 2 which is equal 9160618.31. Thus, A.A.R. = 91.61 per 100,000 populations.

Truncated Rate (T.R.): Doll and Cook (1967) proposed the calculation of rates over the truncated age-ran 35-64 year, mainly because of doubts about the accuracy of age-specific rates in the elderly when diagnos and recording of cancer may be uncertain.

The A.A.R. for i = 8,9 ......,13/15, based on the example of Table 2.

For 35-64 years: Numerator= 4313577.42; Denominator=31000; T.R. (35-64 years) = 139.14

For 35-74 years: Numerator = 7303245.98; Denominator = 36000; T.R. (35-74 years) = 202.87

Cumulative Rate (Cum. Rate): This is the sum of all age specific rates taken from birth to 64/74 years. It can interpreted either as a directly Age Adjusted Rate with the same population size in each age group, or approximation to the Cumulative Risk.

Cum. Rate = $\Sigma\ a_i \times t_i$ for i = 1,2,3.... 13/15, where t_i is the width of the ith age group.

Assuming that the five-year age classes have been used (t_i=5), the above formula can be rewritten as

Cum. Rate = $\Sigma\ a_i \times 5$ for i = 1,2,3.... 13/15.

Using the sample data in Table 2,

Cum. Rate (0 – 74 years) = (4.91+5.83+.........+307.18)*5

= 10876.35 per 100,000 population or 10.9%

Cumulative Risk: It is the probability that an individual would have of developing the cancer in question du a certain age span if no other causes of death were in operation. Usually, it is calculated for 0-64 years or (years assuming it to represent the whole life span of an individual, under consideration.

The Cum. Risk (0-74) = 100* {1- Exp (-Cum. Rate /100)}

= 100* {1- Exp (-10.9/100)} = 10.3%

Thus, in the absence of other causes of death, a male in the sample area has an estimated 10.3% ris developing cancer before the age of 75 years.

CASE FINDING METHODS IN CANCER REGISTRIES

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Cancer registry is an organisation to which all cases of malignant neoplasms (reportable neoplasms) are reported and processed in a standardized manner and used to meet the ultimate goal of cancer control through studies of its epidemiology, morbidity, mortality, treatment, survival patterns and trends of the disease over time. Cancer registry is not just a register of cancer cases. Cancer case finding, abstracting and processing are the important registry functions and these have been standardized by the international committees. Patient record is the basic document of information for identifying a cancer case. The methods for case finding should be carefully planned and would essentially depend on the type of registry to be organised, objectives of the registry and the methods for case recording and case record preservation adopted at the source have to be assessed while organising a cancer registry.

The two methods of cancer case finding are known as 'passive method and active method'. Cancer is not a notifiable disease in India as in some western countries and hence a 'passive registration method' cannot be adopted. An active cancer registration system is adopted in India. In this the registry workers elicit information from the data sources directly. Voluntary reporting of cancer which is also a passive method is not practiced in India. (The Cancer Atlas Project of NCRP did undertake the study through voluntary reporting. In this the fund support extended was for covering the cost of information transfer. Such a possibility for cancer data collection was thus successfully demonstrated). The case finding sources tapped and methods adopted will influence the incidence rate obtained especially when the base population is not large. For instance, if deaths arising in the study population are not included in the identified sources of data collection, the rates obtained will be deficient.

At the outset the registry must specify which types of neoplasms are to be included as registry cases. The National Cancer Registry programme of ICMR stipulates all invasive malignant neoplasms to be registered. All cancer registries will have the following.

- **A reference date**:- This identifies the starting date of the registry. All cancer cases diagnosed after this date are to be registered.

- **A list of reportable neoplasms:-** According to ICD-O codes (site-wise classification) this includes all morphologically proved cases with 5th digit, i.e, behaviour code, 3 or 6.

Correspondingly, the ICD codes (disease-wise classification) C00 to C97 are reportable neoplasms. All clinically, radiologically and biochemically proved cases of cancer are also reportable.

There will be cases which are not yet fully investigated and cases suspected of cancer. Such cases should be kept as a suspense file. These need further scrutiny later before including or excluding in the registry. Generally a four to six months gap is required for such final scrutiny.

Case finding in Population Based Cancer Registries (PBCR)

A population based cancer registry records all cancer cases arising in a specified population. Such population may constitute all people residing in a well-defined geographical area or any other well defined population group. Epidemiological studies are optimally facilitated by population based registry data. Occurrence and distribution of diseases, identification of high-risk groups and factors, trends of the disease over time, cluster of cases etc, which are most essential for control, planning, execution and evaluation can be obtained through population based cancer registries. Such registries can be organised in a specified area like a City, Taluk, District or State or any other well-defined population like occupational groups etc.

In an active registration method the PBCR workers locate cases from hospitals, clinics, pathology laboratories, and death registers kept by the vital statistics departments. By regular visits to hospitals one can attempt to identify clinics and the offices where cancer patients routinely attend. Often ward visits become essential as the patient is admitted as IP. It is essential that other than these, the medical records, the pathology records, the operation theater records are also screened periodically for locating cancer cases. When there is a radiotherapy facility in the hospital almost 60 to 70% of cancer patients should be located in this department.

A PBCR may be covering an area where there is a cancer hospital. This does not mean that all cancer cases arising in the population are attending this hospital. The effort to locate all cancer cases should extend to all other hospitals catering to this population. Within each hospital it is essential to study the patient registration form, the method of record keeping, composition of medical records, and whether both IP and OP records are available etc. If the hospital record systems do not adopt disease coding, retrieval of cancer cases from the medical record storage would necessitate scanning through thousands of patient records. If disease coding is adopted, case finding is made easier. A patient may have several diseases and one should be able to scan through the codes to locate cases. In particular the death records would give 'immediate

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cause of death and 'underlying cause or causes of death. An individual patient may have two or three underlying causes, which are recorded in the death certificates. Pathology and other laboratories in the area diagnose several cancer cases. Here also if disease coding is not attempted, one should scan through all the reports available. Further the patients diagnosed as cancer patients by the pathology laboratories would also have been seen in other hospitals. The same patient might have had the diagnosis of cancer from different laboratories on different occasions, thereby giving different diagnoses. During the processing of the information, the name, address, site of cancer and dates of diagnosis would be used to eliminate duplicates. While establishing a PBCR, the death registration system should be studied, as this is an important source for cancer case finding (*For further reading on mortality data collection for registry, CRAB 2005, pages 32 to 39 which gives the cancer mortality data collection methods adopted by Chennai registry - Dr. Rama et. al and Bhopal registry – Athul Sreevasthava and Sushma Sreevasthava.*)

Apart from these while starting the registry one has to identify the laboratories, which receive tissue specimens for diagnosis. Most of rural areas in India do not have cancer centres or pathology laboratories. To organise a cancer registration system in rural areas of India required great efforts in planning and execution. To make it functional one must have sufficient trained staff available as case finding sources would spread to the neighboring areas and hospitals.

Case finding in Hospital Based Cancer Registries (HBCR)

In a hospital based cancer registry, the effort is to record all cancer cases seen in a hospital. Here the clinical and morphological presentation of the case, treatment and follow up comprised base line information. The data so obtained is critical for studies on patient care evaluation, to mount clinical research studies, clinical trials, evaluation of control measures through analysis of early to late stage presentation etc. Further, the HBCR data provides high quality scientific information for PBCR. In a population, if there are several high quality hospital registries, the recorded data for PBCR would be of high quality. The hospital-based data is analysed for patient survival studies in relation to treatment, stage of disease and other biological parameters. HBCR data has a great utility for medical education and training.

HBCR may be located either in a dedicated cancer hospital or in a general hospital. In a cancer hospital, the patient registration office is the main source for cancer case finding. As most of the cases would be referred cases, cancer registry functions are relatively easier to organise. The Radiotherapy and Pathology departments cooperation is important as in the case of PBCR. These give confirmatory evidence of cancer and case finding efforts should be active covering these departments.

In a general hospital, cancer patients are seen in almost all departments like ENT, Gynaec, Gastr Intestinal, Pulmonary, Orthopedics, Neurology, Urology, General Medicine, Surgery etc and Oncology Departmer if (available). It would be extremely difficult to locate cancer patient in the out patient registration office. Her the patient registration desk, medical record office, pathology department records, I.P and O.P records oncology department are major sources for case finding.

Clinically proved cancer cases are also to be included in the registry. In a hospital cancer group, ther will be some cases which have only a slide review and in certain other cases only reports are reviewed. Thes do not qualify to be included in cancer patient care evaluation. There will also be cases where a patient afte diagnosis at the reporting institution (RI) receive first course of treatment outside, later the treatment is complete in RI. Conversely there will be cases, which receive first treatment in RI but treatment completed in anothe hospital. A set of such conditions are appended in Table 1. The HBCR should decide inclusion or exclusio of such cases while tabulating.

Case finding in Special Purpose Cancer Registries (SPCR)

Special purpose cancer registries focus particular attention to studies on groups who are exposed to either natural or an external environment or to a life style related factor, which are suspected to cause cancer. Studie of groups of persons with cancers of special type like lymphoma, bone tumours, paediatric cancers etc ar conducted according to cancer registry system methodologies. The special purpose cancer registries in way represent etiologic studies.

Case finding for special purpose registries depend on the objectives of the special purpose registrie: Morphology specific registries aim to study the etiology or biologic behaviour or for reaching precise morpholog typing. Pathology records are the main source for this. Exposure related and occupational registries follo the methodology of PBCRs for case finding. Cancer cases among occupational groups may be locate through industry based hospital facilities established by the employer for sickness management.

Cancer case finding thus has to cover a variety of sources. After identifying a cancer case, the mo important activity is to record the information. In this the following steps need to be focused.

(A) Is it possible to contact the patient to get relevant socio demographic information?
(B) Has the diagnosis arrived at least clinically as cancer?
(C) Is it a reportable neoplasm?
(D) Is the case a 'resident' of the population covered by PBCR (only for PBCR)?
(E) What is the first date of cancer diagnosis, is it after the Reference Date of the registry?
(F) Has the patient been examined at the hospitals or only a slide review has been done?

Table. 1 Case presentations seen in Hospitals

CDT – Cancer Directed Treatment (Unless qualified as Palliative)

RI   – Reporting Institution

RD   – Reference Date of the Registry

1.   Diagnosed at RI after RD and total treatment at RI

2.   Diagnosed at RI after RD and treated outside, no treatment at RI

3.   Diagnosed at RI after RD and treated at RI and then outside as planned course

4.   Diagnosed at RI after RD and admitted for palliative care

5.   Diagnosed at RI after RD and treated outside and then at RI (within 6 months of diagnosis)

6.   Diagnosed outside RI after RD and completely treated at RI

7.   Diagnosed outside RI after RD and partially treated at RI and then outside

8.   Diagnosed outside RI after RD and partially treated outside and then to RI

9.   Diagnosed outside RI after RD and treated (or untreated) outside, then come to RI for consultation only

10. Diagnosed outside RI after RD and palliative treatment at RI

11. Only biopsy/resected specimen reviewed in RI after RD.

12. Patient diagnosed after RD and treated outside, came to RI in a critical condition and expired the same day.

13. Patient diagnosed before 'Reference Date' at RI and returns to RI after Reference Date without any previous treatment.

14. Patient diagnosed and treated at RI earlier but returns to RI after reference date with the same cancer

15. Patient diagnosed at RI but comes to RI after reference date with another cancer

Further Reading

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ROLE OF CANCER REGISTRIES IN DETERMINING CANCER MORTALITY IN ASIA

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Burden of a disease can be assessed through a number of epidemiological parameters such as incidenc prevalence, mortality and disability caused by the disease. Study conducted by WHO, World Bank and Harva School of Public in 1990s, developed using sophisticated epidemiological parameters on mortality, morbidi and disability to provide a composite index on burden of a disease like – YLD (Years of Life Lived wi Disability) and DALY (composite Index of Burden of Disease). However data on incidence, prevalence, ar disease specific mortality are frequently incomplete, not very reliable or are lacking in many countries particular in Asia and Africa.

In the absence of dependable data from the Civil Registration System (CRS), many countries hav developed their own Sample Registration System (SRS). Under this scheme in India the SRS collects th information on fertility and mortality indicators at state and national levels. The SRS mechanism involve collection of data through two different procedures. Viz. continuous enumeration and retrospective half yearl survey by a process of matching records and subsequent field verification of unmatched and partially matche events. The methodology provides a cross check on the correctness of events of birth and deaths listed i both the records (Sample Registration System- Report 1998).

In order to estimate the cancer mortality from other than cancer registries paucity of adequate data o one hand and cause-specific death reporting on the other hand make for complexity, particularly in rural populatior In India, major death registration sources are neither reliable nor complete. A large percentage of cases ar unregistered and of the total registered cases, only 10% of deaths are medically certified (Ramanakumar Yeole 2005).

In this contest it is important to mention the quality of death reporting system is very poor in less developed countries including India. Due to several socio-economic constraints cause is not adequatel noted in the death certificates. Sample registration system practice in India helps in this but for correlating with cancer registry data this is not optimally helpful. When cancer morbidity figures from SRS system and cance registry are compared, the SRS figures are at low levels (Ramanakumar & Yeole 2005).

There are three main sources of cancer deaths to be collected in the registry. Vital statistics departments medical records department of collaborative hospitals and active follow-up through telephone, postal enquiries and house visits.

In cancer registries, completeness of registrations, certification of deaths, disease coding practices cause of death, basic information like address and demographic information specially duration of stay and primary cause of death are the main problems to be encountered.

There are a number of reasons for under registration of cancer deaths in cancer registries. The deatl certificates are not available at source of information. The death might have occurred out side the area of

registration. The deaths may not have registered at vital statistics departments. If a cancer patient has long survival and death was not due to cancer there is high a probability that the information that the disease had cancer had been totally forgotten. Migration also play an important role. The death registration system may be defective at vital statistics department. Cause of deaths may be erroneously reported like old age, etc.

Mumbai Cancer Registry was established in 1963 for Mumbai Municipal Corporation area. At present this registry covers about 12 million population having 437.7 sq kms area. The death registration system in Mumbai is quite complete i.e. 98.7% (Gupta & Ramarao, 1973). Reporting of cause of death as far as cancer is concerned is quite good – non specific cause of death is less than 1%. At present 9,500 cancer incidence cases are registered at the Mumbai registry. From the department of Vital Statistics of Municipal Corporation 6,200 cancer deaths are collected out of which 5000 are residents, 800 are non residents and 400 are resident not known.

Method of collection of cancer death information in this registry is that staff of the registry visits the Municipal corporations office to scrutinize all deaths and copies information on deaths due to cancer. Resident deaths to incidence cases gives M/I Ratio. In Mumbai it is 52.6% which is quite comparable with European and developed countries.

Municipal corporation also publishes annual report on vital statistics. When comparison is made for the year 2000 data for cancer death information by the above two sources annual report of municipal corporation has reported only 4320 cancer deaths as against 6200 cancer deaths collected by the registry. This implies that registry has recorded 1880 more cancer deaths (30%) more than that published by the Municipal Corporation.

Reasons for less cancer deaths reporting in the Municipal Corporation report may be due to the fact that they have been looked only at primary cause of death and overlooked the secondary or underlying cause of death.

When the site specific deaths are compared in both the reports deaths due to secondary sites, brain tumours, leukemia, were very minimally reported in the corporation reports. This may be due to lack of training of the coder of vital statistics department. In short, all deaths recorded in Vital statistics offices should be scrutinized by the trained registry staff.

In India other than Mumbai registry, the method applied for few registries for improving cancer mortality is described below.

It is well known that in India except Mumbai death registration system is quite incomplete and cause of death reporting system is not at satisfactory level. When registry started functioning the M/I ratios for Chennai in 1982 was 23%, for Bangalore in 1982 was 17%, for Bhopal in 1987 was 19% and for Delhi in 1987 was 19%.

Chennai registry was established in 1982 by the Cancer Institute, Adayar. At present it covers population of 4.3 million having an area of 170 sq kms. Having incomplete reporting of cancer deaths and poor notification of cause of deaths, this registry has improved the problem of under registration by following way. This registry records all deaths regardless of cause of death from the vital statistics department and hospital records. Then all the deaths are computerized. This data is matched with morbidity data. Matched deaths are then updated to the morbidity data. Unmatched cancer deaths are then traced back by house visits.

Cases with no other details are registered as "DCO's". By this method the M/I ratio of this registry has be[en] improved from 24% to 54% (Shanta and Swaminathan, 2004).

Indian Council of Medical Research, New Delhi has established population based cancer registry [at] Bhopal, in 1986 with the aim to evaluate effect of Methyl Isocynate and cancer. This registry covers 285 sq k[m] area having a population of 1.4 million. Death registration system is far from adequate resulting in und[er] registration of cancer mortality. This registry has identified burial grounds and crematoriums for deaths registrati[on] system implementing same methodology as of Chennai PBCR. It has been shown that M/I ratio, which w[as] around 19% initially has gone to 36% (Bharadwaj and Shrivastav, 2005).

Tata Memorial Hospital, Mumbai, in collaboration with Indian Council of Medical Research, New Del[hi] established the first rural cancer registry at Barshi in the Solapur district of Maharashtra in 1987. At presen[t] covers 0.4 million population with an area 3717 sq kms. Information on deaths is collected from village dea[th] records and also from the local community. As death records are not generally medically certified relatives [of] all diceased are contacted to collect the relevant information to assist in "follow-track" to the medical records [of] the treating hospital or physician to identify proven cancer cases. In this registry the M/I ratio is 79% (Dinsh[a] and Nene, 2005).

Many registries collect the follow-up information for survival studies. This procedure is also helpful [to] improve the cancer mortality in registries. Mumbai cancer registry collects the follow-up information for most [of] the major sites after 5 years for each case. To get the follow-up information, the methodology used is, firs[t] match with the cancer deaths collected from the vital statistics department (50%). To get a follow-up informati[on] from remaining patients by telephone and postal enquiries (15%) and house visits (10%) are carried out. D[ue] to this procedure there has been improvements in cancer mortality about 10% (Sankaranarayanan et al, 199[8]).

Special cross sectional surveys in registration areas are also helpful in improving cancer mortal[ity] statistics of the registry. Tata Institute of Fundamental Research, Mumbai has carried out a special heal[th] survey for Mumbai City population during 1991-94. In this survey, the information on deaths has also be[en] collected when survey data and Mumbai registry data has been matched for cancer mortality. It has be[en] observed that there has been improvement of 4.2% in cancer mortality.

Effective use of cancer registries for cancer survival research has been shown by Pakitil et al. in 200[?] Two hospital cancer registries in USA were used to recruit a large sample of breast cancer survivors for a stu[dy] examining the late reproductive effects of breast cancer treatments. These two cancer registries had excelle[nt] sources of identifying a large sample from long term breast cancer survivors. Although there are son[e] limitations to this approach including non response of a significant number of breast cancer survivors, tumo[r] registries represents an important resources for the rapid identification of cancer survivors for research studie[s]. Findings from this study suggested several enhancements for future study that may increase the yield fr[om] registry recruitments.

Cancer mortality through cancer registries in Asia, Africa, may be improved as follows :
It is well known that usual method of mortality data collection as in the west will not give reliable and comple[te]

data. It is absolutely necessary that improvements in the system of registration of deaths include implementation of standard core information mortality form in all hospitals, nursing homes in the registration area and at birth and death registration units of vital statistics department and at burial grounds and crematoriums. For improvements in the system of certification of cause of death stress on underlying and antecedent cause of death should be given. Medical personnel should be educated on the method of certifying cause of death. Cancer registration topic should be introduced in the curriculum of final year MBBS at least one question on this topic in any clinical subject. Verbal autopsies have to be more rigorous and standardized procedures before exact cause of death can be ascertained.

In conclusion, cancer mortality assessment is an important aspect for any cancer control programme. Cancer registries provide a base for evaluating cancer mortality. Because of the scientific discipline in cancer registration system the mortality rates obtained through cancer registry will be optimally productive. In Asia in general and in India in particular cancer registries have played a crucial role in providing improved cancer mortality data.

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DEALING WITH SMALL NUMBERS IN CANCER REGISTRIES

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Incidence and mortality rates reported by the Division of Chronic Disease Prevention and Adult Health U.S.A. are often are marked as being unreliable if they are based on fewer than 20 cases or deaths. Similar the National Center for Health Statistics does not publish or release rates based on fewer than 20 observation because they feel that such data do not meet their requirement for a minimum degree of accuracy. They ba the accuracy requirement on a measure called the relative standard error (RSE).

Standard error of the rate: For crude rates, the standard error (S.E) is calculated as follows:

$$S.E = rate/\sqrt{cases}$$

$$\text{Relative Standard Error (R.S.E)} = (Standard\ Error/rate)*100$$
$$= (\ rate/\sqrt{cases})*(1/rate)*100 = 100/\sqrt{cases}$$

The R.S.E. is the standard error as a percent of the rate itself. The R.S.E. of an incidence or mortality rate based on the number of cases or deaths, unlike the standard error, which is based on both the number cases and the size of the population. It can also be applied to age-adjusted rates. It can be seen from Tab 1 that R.S.E. stabilizes as the number of cases reaches to 20, thereafter the change in R.S.E. is not that rapi But, when the number of cases is below 20, it changes rapidly. Hence, it is suggested that the rates to b calculated only when they are based on more than 20 cases. Rates calculated for fewer than 20 cases a unreliable or unstable.

Table 1: R.S.E. and Number of cases

No. of cases	R.S.E.
1	100
2	71
5	45
10	32
20	22
40	16
60	13
80	11
100	10

The National Cancer Registry Programme (ICMR) at Bangalore is receiving data annually on cancer incidenc cases from the following Population Based Cancer Registries in India.

1. Bangalore –Urban (1982)
2. Barshi –Rural (1987)
3. Bhopal – Urban (1986)
4. Chennai – Urban (1982)
5. Delhi – Urban (1986)
6. Mumbai – Urban (1982)
7. Guwahati – Assam – Urban
8. Dibrugarh – Assam – Rural+Urban
9. Silchar – Assam – Urban
10. Aizawl – Mizoram – Rural+Urban
11. Imphal – West – Manipur – Rural+Urban
12. Gangtok – Sikkim – Rural+Urban

The six north east registries started functioning from the year 2003 while the old registries are functioning since more than 20 years. The year in which tha registries started functioning is shown in the bracket against their names.

The data received on incidences is analyzed and expressed in the form of various rates like Crude Rate (C.R.), Age Specific Rate (ASpR), Age Adjusted Rate (A.A.R.), Truncated Rate (T.R. 35-64 / 35-74 years). In order that all these rates are reliable, it is essential that they should be based on at least 20 cases, as mentioned earlier. There are 52 sites for males and 56 sites for females for which C.R., A.A.R., ASpR and T.R are reported. It is quite possible that all sites may not have adequate number (>20 cases) to report.

Consider an example where the rates reported are unstable and examine how they lead to different conclusions from one year to another year. The age specific incidence rate of salivary gland cancers for Bangalore - males for the period of 1997-98 and 1999-2000 are shown in the Table 2. Looking into the 1999-2000 data, one can conclude that incidence rate below 35 is nil but the data of 1997-98 shows the other way. Similarly, based on 1997-98 data, one can conclude that the incidence is nil for persons above 70 years while the data of 1999-2000 do not support the same conclusion. Hence, when the rates are based on fewer cases, it may not give reliable or consistent results, over the years.

Table 2 : Age Specific Incidence Rate - Salivary Glands - Bangalore- Males - 1997-98 & 1999-2000

Age group	1997-98	1999-2000	Age group	1997-98	1999-2000
0 - 4	-	-	40 - 44	0.3 (1)	-
5 - 9	0.2 (1)	-	45 - 49	0.8 (2)	1.1 (3)
10 - 14	-	-	50 - 54	0.5 (1)	1.0 (2)
15 - 19	0.2 (1)	-	55 - 59	1.6 (2)	2.2 (3)
20 - 24	0.3 (2)	-	60 - 64	5.1 (6)	2.4 (3)
25 -29	0.2 (1)	-	65 - 69	1.5 (1)	-
30 - 34	0.4 (2)	-	70 - 74	-	1.7 (1)
35 - 39	-	0.2 (1)	>= 75	-	1.5 (1)
		Total	0.37 (20)	0.24 (14)	

Figures in Brackets represents Percentages

Few suggestions are given below to overcome the problem of fewer cases in reporting:

1. Combine the number of Cases or Deaths over several years.
2. Provide Two/Three/Five years average Annual Rates.
3. The number of Cases or Deaths can be combined across Geographic Areas e.g. using the rate for a region instead of for an individual District in a State.
4. The rates can be given for every 10 yearly age interval.

Chronic Disease Teaching Tools - Rates Based on Small Numbers

Ref: http://www.health.state.ny.us/nysdoh/

IMPORTANCE OF COMPLETENESS OF CASE RECORDS IN THE PERSPECTIVE OF CANCER REGISTRY

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Cancer registries have become centers of excellence for the collection, storage and analysis of data rela to malignant diseases, and are aiming to create systems to record accurately and comprehensively the on cancer cases. Indian registries are moving in this direction realizing the need and importance of such exercise. Owing to 'local problems' of the registries, the totality of the efforts still needs to be realized. the two decades of experience in registry operations in India, National Cancer Registry Programme (NCRI making efforts to assist/guide registries to transform the 'cancer registries' to 'cancer care registries' by broader still further the data set that is captured for each case of cancer and to record additional patient details such treatment management, follow-up etc. The rapid development of electronic patient data management syste within hospitals can obviously facilitate such an extension of the data set. On one hand technology for regist to store and analyze much more information about cancer diagnosis and management is advancing. On other hand, the basic problem of recording data in the source documents (e.g. case files) has remained same which is of great concern for the registries to become "cancer care registries". Although, some of registries have accepted the challenge of this transformation, the problems specific to each of these cente hospitals have prevented from providing a comprehensive picture on the cancer data in totality. The pres article tries to share some thoughts on the problems faced by some of the registries in augmenting the "can care registry".

The data collection of the registry program under the NCRP commenced from 1, January 1982. other words, the older registries have completed more than two decades of registry experience. Seve registries have undertaken and completed many epidemiological studies also. But the real lacunae of cancer registry are the non availability of complete information in the medical case records that is required abstraction by the cancer registry personnel to conduct end result (survival) studies in addition to missing ca records. Completeness of the medical case records is the most important pre-requisite to provide quality da by a cancer registry. Many cancer centers including KMIO would see more than 15,000 – 20,000 new case

every year. However, if one looks at the proportion of cases confirmed to have cancer diagnosis, it would range between 50-80% and this proportion varies from centre to centre. Here, it is not the intention to criticize the lacunae's in the system at individual centers, but the need for completeness of the record is stressed. To improve this situation, the senior staff of the registry should conduct periodical lectures/meetings for clinicians and emphasize the need for quality and completeness of data on clinical parameters. This might help in the data collection on patients to the maximum. In addition, highlight the facts to the Principal Investigator or can talk to the clinician's forum such as the Clinical Society/Heads of Departments meeting. The outcome of such efforts may help (although not significantly) to a fruitful extent. The in-completeness of the records is seen in the following stages:

1. Patients dropping out before confirmation of diagnosis.
2. After the confirmation of the diagnosis but prior to any kind of treatment.
3. Patient's refusal for any kind of treatment after planning.
4. Patient dropout after taking part treatment
5. Patients dropping out after completing the prescribed cancer directed treatment.

All the above factors is a serious concern to the registry personnel to complete the required information to the cancer registry and more so for the Hospital Based Cancer Registry. At least the Regional Cancer Centers where the Hospital Based Cancer Registries are functioning, efforts should be made to minimize the in-completeness of information in the case records and to provide as much data as possible on diagnosis, staging and treatment on all cancers. Initially, intensive data on management/follow-up can be generated on specific cancers (e.g. common cancers) enabling the registries to study the pattern of care/survival. One way of improving this is to introduce all the relevant items contained in the core proforma to the case records and to make the concerned speciality/OPDs responsible to document this information compulsorily.

The Resident Surgeons should check for the completeness of case records of their specialty every day and complete the information with the guidance of the treating clinicians.

Weekly review of all the case records by the Resident Surgeons of each speciality.

Apart from the above, each and every patient must be provided with counseling immediately at the first presentation to the hospital/ after the diagnosis giving the information about the nature of disease, importance of completeness of treatment and follow-up.

POPULATION BASED CANCER SURVIVAL ANALYSIS

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Cancer survival estimation is an important aspect for assessing the overall strength of cancer care in a region. Population based cancer registries provide survival probability in unselected groups of cancer patients and useful to evaluate the effectiveness of cancer care in the community. There are a few methods to estimate survival probability (overall) such as the actuarial (life-table) method (Berkson and Guge, 1950; and Cutler and Ederer, 1968) and the Kaplan-Meier (product-limit) method (Kaplan and Meier, 1958).

Monitoring of cancer patient survival, is an essential task for both hospital and population-based cancer registries. Using the above two methods, long-term survival has been derived in a cohort-wise fashion, i.e. from cohorts of patients diagnosed at least say 5 or 10 years ago who have been observed with respect to vital status over 5 or 10 years since then, respectively. The survival figures may be out dated at the time they can be derived (i.e. after a follow-up of at least say 5 or 10 years) in case of recent improvements in diagnosis / treatment. A method for estimating up-to-date long-term survival of patients with cancer by period analysis is available (Brenner and Gefeller, 1996).

When calculating the overall survival (in cohort and period approach), cause of death is not taken into account. People with cancer generally experience a much lower overall survival probability than the general population. The overall survival for people with cancer is being considered as the result of two components, deaths due to cancer and deaths due to all other causes. Thus a net survival can be defined as 'the survival, which may occur if the risk of death other than cancer under study are removed from the overall survival (Chiang 1968). There are a few methods to estimate net survival such as cause specific survival and relative survival (Ederer et al, 1961).

In statistical theory, an estimate of true parameter value could be known only if the units of observation is infinitely large. Hence it is useful to present some measures of precision of the estimates. The precision is measured using standard error (SE) of the estimates. There are a few methods to estimate SE for survival probability (Greenwood, 1926; Peto et al, 1977; Breslow 1970). The difference between two or more survival curves can be tested by using some rank tests (Mantel 1966; Kalbfleich and Prentice 1980).

The present communication describes the various methods currently used for estimating overall survival, net survival, their standard error and significance test for comparing survival. The advantages and pitfalls of the various methods are discussed. The methods are illustrated using a hypothetical data.

Basic Terminologies for Estimating Survival Probability

1. Starting data

For estimating survival probability, a group of individuals with some common morbidity experience is followed up from a well-defined starting date. Commonly used starting dates in population-based cancer survival estimation are date of diagnosis and date of first visit to hospital (date of registration).

2. Common closing date

All individuals in the study are followed up to a common closing date of the study.

3. Status at common closing date

The status of each individual is to be assessed at the closing date of the study.

When the period of follow-up ends, some patients would be died. Some patients would still be alive and they have to terminate the follow-up due to closure of the study. Such patients are called 'withdrawn alive'. Some patients would be lost to follow-up before the end of the study. "Withdrawn alive" and "lost to follow-up" patients are called 'censored observations'.

Figure 1. Hypothecal data : Patient recruitment and follow-up
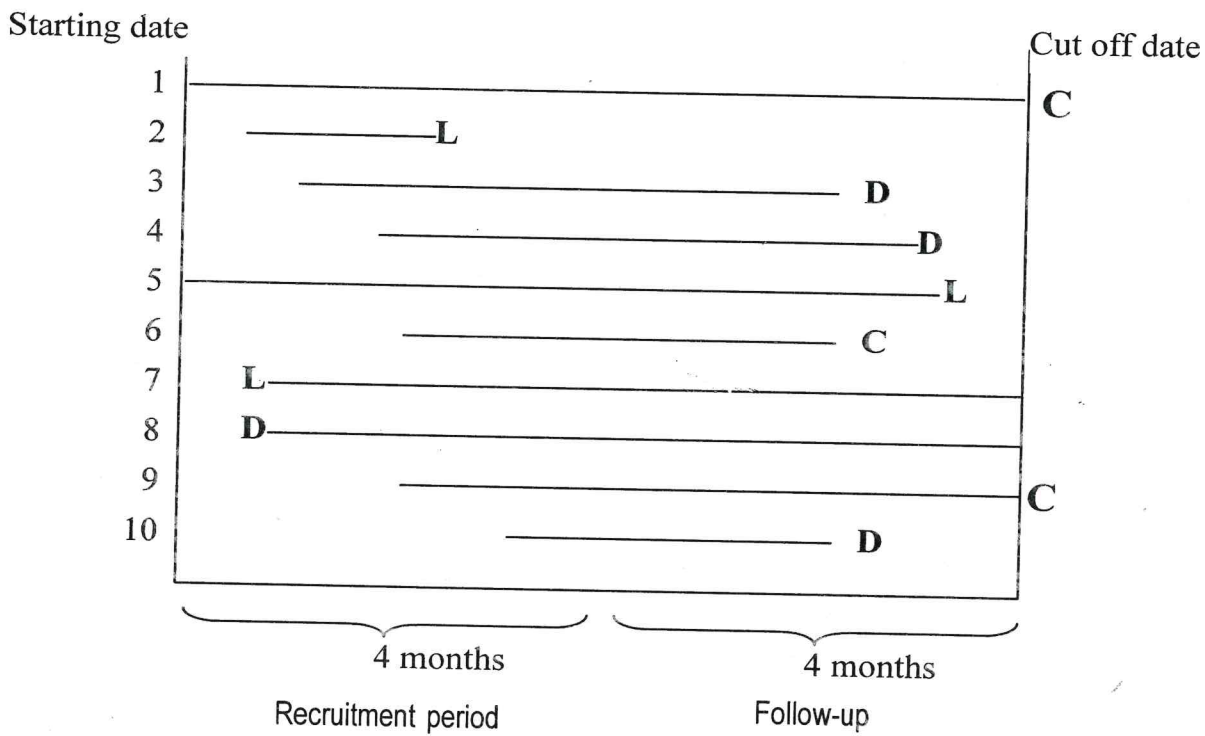
Figure 2. Hypothetical data : Length of follow-up of 10 patients (in months) in ascending order
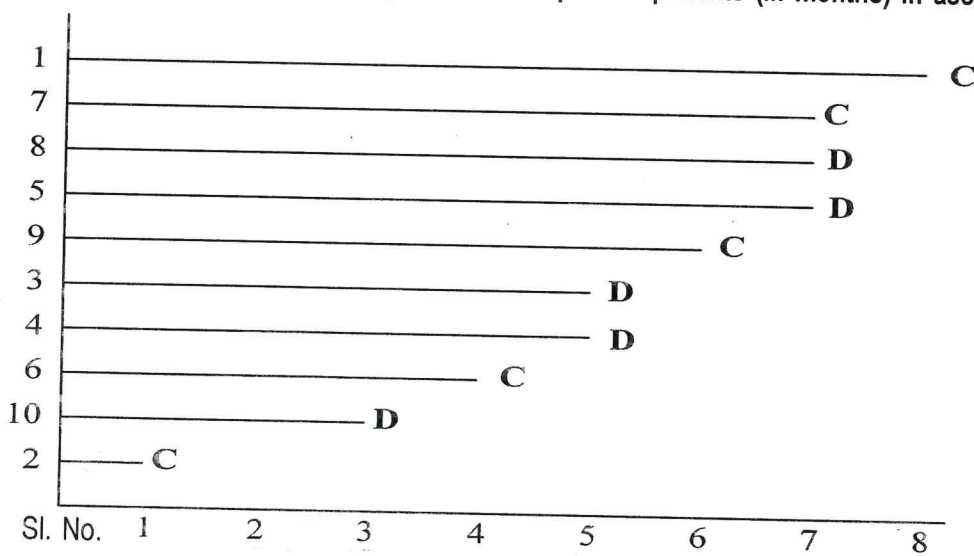
Figure 1 presents 10 patients recruited during a period of 4 months and are followed-up another 4 months. Two patients were 'withdrawn alive' (C) due to closure of the study, 2 patients lost from follow-up (L) and 5 patients died (D) during the follow-up.

Another component for estimating survival probability is the length of follow-up, which is defined as the time from the starting date to the end of the study for 'withdrawn alive' patients. For 'lost to follow-up' patients, length of follow-up is measured from the starting date to the last date of follow-up and for dead patients it is the time from the starting date to the date of death.

Survival probability is the probability that an individual survives longer than time 't'. i.e. $P(t) = Pr(X > t)$, where the random variable X is the individual survival time.

Methods of Estimating Survival Probability

1. Life-Table Method

The first step is the division of the maximum follow-up time into intervals. The intervals can be of unequal sizes. The second step is the calculation of the number of observations exposed to the risk of dying (N_i) which is obtained by subtracting half the number of subjects censored during the interval from the number at the beginning (n_i) of the interval [$N_i = n_i - C_i /2$]. The figure thus termed is the 'effective number at risk'. The next step is the computation of the conditional probabilities of death (q_i) in each interval, which is calculated by the ratio of the effective number at risk (N_i) to the number died (d_i) during each interval ($q_i = d_i / N_i$). The conditional probability of survival (p_i) during each interval is then calculated by subtracting the conditional probability of death from 1 ($p_i = 1 - q_i$).

The survival probability at the end of a given interval (i) is obtained by multiplying the conditional probabilities of survival over all the intervals up to this time point ($P_i = p_1 \times p_2 \times ... \times p_i$), and this is called the cumulative survival probability.

The life-table method for calculating survival rates using the available follow-up information on the ten patients based on the hypothetical data in Figure 1 is illustrated in Table 1. An interval of 2 months had been used. Loss to follow-up and withdrawn alive (due to closure of the study) patients are treated in the same way and are considered as censored observations. The 4 months and 8 months survival probabilities are 65% and 33% respectively.

Table 1. Computation of survival probability by the life-table method

Interval Start Time (i)	Number exposed to the risk (ni)	Number Withdrawn During Interval (ci)	Effective Number at Risk (Ni)	Number of Terminal Events (di)	Probability of death (qi)	Probability of Survival (pi)	Cumulative probability of survival (Pi)
0.0	10.0	1.0	9.5	0.0	0.0000	1.0000	1.0000
2.0	9.0	0.0	9.0	1.0	0.1111	0.8889	0.8889
4.0	8.0	1.0	7.5	2.0	0.2667	0.7333	0.6519
6.0	5.0	2.0	4.0	2.0	0.5000	0.5000	0.3259
8.0+	1.0	1.0	0.5	0.0	0.0000	1.0000	0.3259

Figure 3. Observed survival by Life-table method

Time (months)
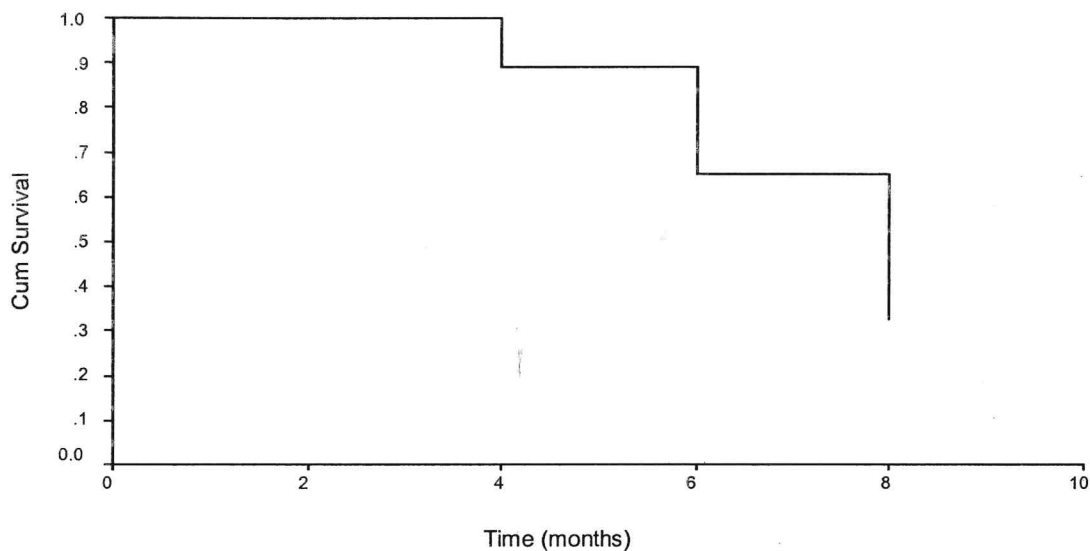
Kaplan-Meier (K-M) or Product-Limit (P-L) method

Kaplan and Meier proposed a varied approach to life-table method in which the necessity for grouping the data in pre-fixed time intervals was removed. The time intervals are determined by the occurrence of event (death), as and when they occur. The length of follow-up of all observations in the study is to be arranged in increasing order of magnitude (Figure 2). The procedure relies on the same principles as described in the life-table method. In the K-M method, the conditional probabilities of survival are estimated every time an event occurs. These are estimated from the number of observations at risk at the time of each event occurs.

The number of observations at risk is obtained by subtracting all censored observations prior to the occurrence of outcome. The cumulative survival probability at any given time point is obtained by the product of all conditional probabilities of survival calculated at each outcome occurs up to the time point under consideration. This method requires the calculation of as many survival probabilities as there are events, except if several events occur on the same time.

Table 2. Computation of Survival Probability by the Kaplan-Meier Method

Time (Months)	Status	Cumulative Events	Number Remaining	Cumulative Survival
1	0	0	9	
3	1	1	8	0.8889
4	0	1	7	
5	1	2	6	
5	1	3	5	0.6349
6	0	3	4	
7	1	4	3	
7	1	5	2	0.3175
7	0	5	1	
8	0	5	0	

Table 2 also shows the details of the calculation of survival probability employing the Kaplan-Meier method using the same hypothetical data set given in Figure 1. One patient died at the 3rd month and one patient censored at 1st month. Hence the conditional probability of surviving for at least 3 months is 8/9 (89%). Similarly 2 deaths occurred at 5th month and one patient censored before completing 5 months of follow-up. Hence the cumulative probability of survival at this month is 63% (0.8889 x 0.7143 = 0.6349). This rate remains the same till 7th month as no deaths occurred in between. Two deaths occurred at 7th month and hence cumulative survival probability for at least 7 months is 32% (0.6349 x 0.5). As no deaths occurred after 7th month, survival probability remains same till the completion of the follow-up period. Hence the 8 months cumulative survival probability using K-M method was 32%.

Figure 4. Observed survival by Kaplan-Meier method
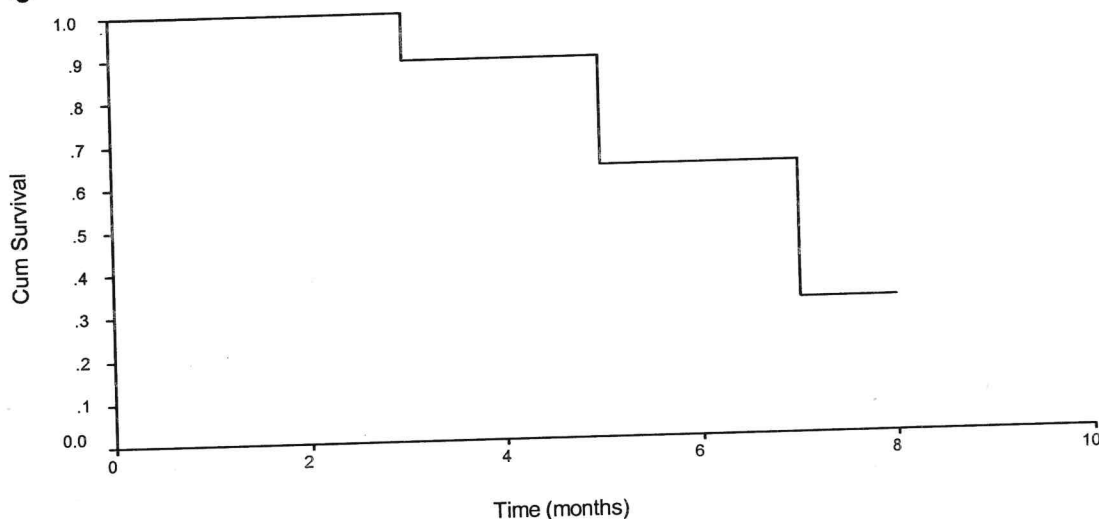
Survival Curves

Survival curves can be plotted using the above two methods which consist of horizontal lines with vertical steps. The vertical steps in the life-table method correspond to the number of events in each (pre-fixed) interval (Figure 3). In the K-M method, the vertical steps correspond to each event (Figure 4). The magnitude of the step is related to the number of observations at risk and the number of events occurring. The vertical axis of the curve (in both methods) represents the survival probability for members of the study group. The points on the survival curve are the best estimate of the cumulative survival probability for members of the study group.

The survival probability (cumulative) at the beginning of the curve is more definite and reliable in both the life-table and the K-M method, because a greater number of observations are at risk during these time intervals. However, at the tail end of the curve, the number of observations at risk is relatively small because of increased censored observations resulting in fewer patients being followed-up for that length of time.

Long-term survival curves of patients with cancer by period approach

The principle of period analysis has been described in detail earlier (Brenner and Gefeller, 1996; Swaminathan 2005). Briefly, period estimates of survival for a recent time period are obtained by left truncation of observations at the beginning of that period in addition to right censoring at its end. In this approach, the most up-to-date survival curves of cancer patients could be obtained. Using the traditional cohort-wise survival analysis, observations are not left truncated. In both cohort-wise and period-wise analysis, life-table or Kaplan-Meier approach can be used to calculate the conditional survival probabilities.

Methods for estimation of net survival rates

All deaths occurring among the subjects, including deaths from causes other than cancer, are considered as 'failures' in the calculation of overall survival (period and cohort approach). Overall survival should therefore be considered as the result of two components, corresponding respectively to deaths due to cancer being studied and to deaths due to all other causes taken together. If the risks of death other than the cancer under study can be removed from the overall survival, deaths attributable to the cancer under study (net probability of death) can be estimated. Its complement is none other than the net survival. To describe the deaths attributable to the disease under study, there are two classical methods available, the method of cause-specific survival and that of relative survival. The determination of net survival implicitly assumes that the risk of death from the cancer being studied and the risk of death from other causes are independent.

Cause-specific survival

When reliable information on cause of death of all registered cancer patient is available, cause-specific survival can be obtained by considering cases for which cause of death other than the registered cancer as censored observations. i.e. only those deaths occurring due to the disease of interest are considered as failures while other deaths are considered as simply termination of follow-up (in the same way as cases lost to follow-up or withdrawn alive). Calculation of cause-specific survival can be carried out by the life-table method or by the Kaplan-Meier method.

The method of cause-specific survival can be applied only when the cause of death is recorded. Information on cause of death is some times unavailable or unreliable. It is frequently difficult to classify the cause of death of cancer patients into a cancer death or non-cancer deaths. In India, only for Mumbai city reliable data on cause of death is available as all deaths have to be medically certified according to coroner's act. In urban areas information on cause of death is obtained in some instances through inpatient medical records of hospitals. Due to the absence of a central death registration system, the certification of cause of death is incomplete. In rural areas, information on cause of death is collected through paramedical workers. As the mortality statistics in India are deficient due to incomplete entry in the death certification, relying on death registers is insufficient for cause-specific survival studies. Relative survival can be calculated under these circumstances.

Relative survival

The method of relative survival does not require knowledge on the cause of death and thus avoids the difficulties associated with its determination. Relative survival refers to the ratio of the observed survival to the expected for a group of people in the general population, similar to the patient group with respect to age, sex and calendar period of observation.

The method of relative survival is based on the assumption that the general mortality, as it is described by the life-table of the population, adequately takes into account of all the causes of mortality, except for the specific cause under study. In India, sample registration system (SRS) based abridged life-table is available in the vital statistics division, office of the registrar general of India. The life-tables for 5-year "normal" survival probabilities based on mortality experience in calendar years separately by urban and rural areas, by sex and by major states and the country are available (SRS based life tables, 1995). The appropriate probability, depending on the sex and age of the patient and the calendar year of entry to observation can be used for calculating the expected survival rate of the group for subjects under study.

The cause due to cancer is considered to be negligible in comparison to all other causes of death. Only in this condition, relative survival can provide an acceptable approximation to net survival. If this assumption does not hold, net survival will be overestimated as a result of the increased estimation of the mortality due to other causes. Mortality from a specific cause constitutes a negligible fraction of total mortality. Hence, survival computed from general population life-tables provide satisfactory estimates of expected rates in analysing survival of cancer patients by cancer of specific sites.

Confidence interval for standard error and survival

The survival probability based on a sample of observations are frequently used to generalize to a larger population. In the selection of samples, sampling variation occurs. Standard error (SE) is a measure of the extent to which the sampling variations influence the computed survival. Thus estimation of SE for a survival probability becomes essential especially when its calculation is carried out on small group of patients. Several formulae have been proposed for the computation of SE and then confidence intervals for survival probability at a given point.

The choice between the many different ways of calculating the confidence interval depends on practical considerations and on how conservative an estimate is required. A rough estimate of the SE for a survival probability (P_i) at the end of a given interval 'i' can be calculated by using the formula of Peto et al (1977) which is

$$SE(P_i) = \sqrt{P_i(1-P_i)/N_i}$$; where N_i is the number of observations at risk during interval 'i'. On the assumption that P_i will have an approximately normal sampling distribution, the 95% confidence interval for P_i is $P_i \pm 1.96\ SE(P_i)$.

Another formula suggested by Greenwood (1926) for the standard error of P_i based on an estimate of the variance of P_i is

$$SE(P_i) = P_i \sqrt{\sum_{j=1}^{i} [d_j / N_j(N_j - d_j)]}$$

where N_j is the number of observations at risk and d_j is the number of deaths during interval 'j'. On the assumption that P_i will have an approximately normal sampling distribution, confidence interval can be calculated.

Rothman in 1978 [Kalbfleich and Prentice, 1980] suggested another formula to calculate confidence interval whose limits always lie between 0 and 1 and which is

$$\frac{n_0}{n_0 + z^2_{\alpha/2}} \left[P_i + \frac{z^2_{\alpha/2}}{2n_0} \pm z^2_{\alpha/2} \sqrt{\frac{P_i(1-P_i)}{n_0} + \frac{z^2_{\alpha/2}}{4n_0^2}} \right]$$

where $n_0 = P_i(1-P_i)/V_i$, V_i is the Greenwood's variance and z_α is the standard value of Z-statistic at α level of significance.

The confidence interval for observed survival probability derived by Peto et al (1977) can go outside the range 0 to 1 for small sample size or for very large or small probabilities even though it is an easily obtained estimate of the magnitude of the variability of the survival probability estimate. Hence, it is not a good approximation for small samples or for very large or small survival probabilities. As the formula for standard error derived by Greenwood (1926) depends on the estimate of the variance, it can lead to an underestimate of the variance for long time intervals when the sample size is not sufficiently large. Hence it is valid for large samples only. It has been shown by Anderson et al (1982) that Rothman's method with Greenwood's variance on an average provides the most satisfactory result.

The above formulae can be used for estimating confidence interval for cause-specific survival rates too. The confidence interval for relative survival is proportional to that of the observed survival if random variation in expected survival can be assumed to be negligible. The standard error of the relative survival is thus obtained by dividing the standard error of the observed survival to the expected survival.

Methods for comparing survival probabilities

Z-test *to compare two survival probabilities*

Comparison of survival estimates between two groups can be made at any time point on the survival curve. The standard Z-test provides a numeric estimate of the probability that a difference as large as that observed would have occurred if only chance were operating.

If P_1 and P_2 are the survival probabilities at one time point for two groups 1 and 2, and $SE(P_1)$ and $SE(P_2)$ are the standard errors for P_1 and P_2 respectively then the statistic Z is calculated by the formula:

$$Z = \frac{|P_1 - P_2|}{\sqrt{[SE^2(P_1) + SE^2(P_2)]}}$$

where $|P_1 - P_2|$ is the absolute value of the difference in survival probabilities. If the null hypothesis is true Z is approximately followed a normal distribution. i.e. if the observed value of Z for a particular set of data is equal to or more than 1.96, then the probability that a difference as large as that observed occurred by chance is five percent or less.

Rank tests to compare survival curves

The difference between two or more survival curves can be tested by making optimum use of the available information about the survival of patients in different groups by using same rank tests. One commonly used rank test is log-rank test (Peto et al, 1977). This test is designed particularly to detect a difference between two or more survival curves, which results when the mortality rate in one group is consistently higher than the corresponding rate in a second group and the ratio of these two rates is constant over time.

If O_1 and O_2 are the observed number of deaths in two groups 1 and 2 and E_1 and E_2 are the corresponding expected number of deaths, then the log-rank statistic (T) used for comparison purposes is

$$T = (O_1 - E_1)^2/E_1 + (O_2 - E_2)^2/E_2$$

Based on the number of individuals in each group who are alive just before the observed death time and the total number of deaths observed at that time, expected number of deaths in each group could be calculated. If the null hypothesis is true, T is approximately distributed as a Chi-square distribution with one degree of freedom. i.e. if the observed value of T for a particular set of data is equal to or more than 3.84, then the probability that a difference as that observed occurred by chance is 5% or less.

There are a number of other tests for comparing the survival of two or more groups. The generalization proposed by Breslow and Gehan of the Mann-Whitney test (or the Kruskal - Wallis test for more than two populations) is similar to the log-rank test (Breshw, 1970; Mantel 1966; Kalbfleich and Prentice, 1980). Gehan-Breslow test is based on a comparison of observed deaths with expected deaths in a group at each time point where at least one death is observed. The test only differs in the weight given to the difference between the observed and expected deaths in each group. Another commonly used test is Peto's generalised Wilcoxon statistic (Peto et al, 1977). This method differs from the log-rank test in that it attaches more importance to early deaths than to later deaths, whereas log-rank test gives equal weightage to all deaths.

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Section III

Highlights from cancer registries

POPULATION BASED CANCER REGISTRY, MUMBAI
Indian Cancer Society, Parel, Mumbai

Principal Investigator   Dr. A.P Kurkure

Co - Investigator   Dr. A.B Yeole

SCIENTIFIC PUBLICATIONS

1. Coping mechanisms among long-term survivors of breast & cervical cancers in Mumbai, India. A.V.RamanaKumar & B.B.Yeole. Asian Pacific J Cancer Prev, 6(2),189-194, 2005.

2. Assessing cancer burden in rural India : An analysis by cause of death statistics. A.V.RamanaKumar & B.B.Yeole. Asian Pacific J Cancer Prev, 6(2),221-223, 2005.

3. Epidemiology of cancer in particular reference to India by B.B.Yeole in Cancer A Cytogenetic and Molecular Approach. (ed) V. Rai, Alahabad, 29-38, 2005.

4. Cancer incidence & mortality in Greater Mumbai, 2001, A.P.Kurkure, B.B.Yeole, Lizzy Sunny, S.S.Koyande., Mumbai, 2005.

5. Respiratory cancer population–based Survival in Mumbai, India, B.B.Yeole, Asian Specific Journal of Cancer Prevention , Vol.6, 449-454, 2005.

6. Social inequalities in cancer with special reference to South Asian Countries, A.P.Kurkure and B.B.Yeole, Asian Pacific J Cancer Prev, Vol.7, 2006.

7. Epidemiological assessment of lung cancer of India, B.B.Yeole, A.P.Kurkure, in The Oncology Knowledge Bank-Lung Cancer, Vol 1, 2006, Mumbai, India, 9-18.

8. Cancer incidence and mortality in Greater Mumbai 2001, A.P.Kurkure, B.B.Yeole, Lizzy Sunny, S.S.Koyande, Indian Cancer Society, Mumbai, 2005.

9. Cancer incidence and patterns in Urban Maharashtra-2001, A.P.Kurkure, B.B.Yeole, S.S.Koyande, Indian Cancer Society, Mumbai, 2006.

CONFERENCES / MEETINGS

1. Dr. B.B. Yeole, Deputy Director, has been invited by ICMR, New Delhi, to work as an Advisory Committee Member for the Cancer Atlas Project. Dr.Yeole attended the meeting on 7th March 2006, New Delhi.

2. National Cancer Registry Programme of Indian Council of Medical Research and World Health Organisation organized ("Expert Committee Workshop") on Development of an Atlas of Cancer in India in North East Region on 2nd and 3rd September 2005 at Kolkatta. Dr.B.B.Yeole has been invited to attend the workshop and given the presentation on "Working of Mumbai Population Based Cancer Registry".

3. The 36th International Symposium of the Princess Takamastu Research Fund have organized an International Conference on "Development in Cancer Epidemioglogy- Prospectus for Cancer Control in the Asian Pacific" at Tokyo Japan during 17-19 November 2005. Dr.B.B.Yeole has been invited this meeting and given a presentation on "Role of Cancer Registry in determining Cancer Mortality in Asia".

4. NCRP (ICMR) organized a meeting to update coding manual of population based cancer registries at Bangalore during 14-17 June 2005. On invitation Dr.B.B Yeole participated in this meeting.

5. NCRP (ICMR) organized Annual Review Meeting of cancer registries and Workshop at Kolkata during 9-12 November 2005. At this meeting Dr. B.B. Yeole, Deputy Director presented the findings of Mumbai Cancer Registry data for the year 2002 and historical background and findings based on the 2002-data collected by Pune, Nagpur and Aurangabad registries.

6. Action Council Against Tobacco- India, organized a National Tobacco Conference at Mumbai during Jan 27-29, 2006. Dr.B.B.Yeole participated in this conference and Presented a paper "Tobacco related Cancer Incidence Patterns in Urban Maharashtra".

TRAINING PROGRAMME

1. NCRP (ICMR) organized a workshop on cancer registration at Kolkatta, during 9-10 November 2005, Mrs.Shravani Koyande and Mrs.Suchita Hirve (Mumbai), Mrs.Rajashree Ingole & Mrs. Rekha Bhagat (Nagpur), Mr.A.M.Waghmare (Aurangabad), participated in this workshop.

2. International Agency of Research on Cancer organized a course on Summer School on Cancer Epidemiology at Lyon, France during 27th June – 22nd July,2005, Mr,N.G.Shastri, Statistical Assistant, attended the course.

PROJECTS COMPLETED

1. **To estimate the population survival rates for major sites registered during 1995-1999 in Mumbai.** This project was being carried out in collaboration with the International Agency for Research on Cancer, Lyon, France.

   To know the survival status of cancer patients matching with death certificates, telephone and postal enquiry, house visits and securement of original records has been carried out.

2. **WHO project "Development of Cancer Atlas for India"**

   i. Include information on non-resident cases registered in Mumbai Registry (Except Tata Memorial Hospital) during 2001 and 2004.

   ii. Include information on non-resident cases registered in Pune, Nagpur and Aurangabad registries during 2001 and 2004.

3. **Entering the Aurangabad Cancer Registry data in CANREG-4 system (Funded by International Agency for Research on Cancer, Lyon, France)**

   Since 1978 to 2004 there are about 8000 cancer incidence cases registered in Aurangabad Cancer Registry, all these data are entered in CANREG-4 system.

4. **Entering the variable: Name (first, middle, surname) for all the incidence cases for the year 1964-85 of Mumbai Cancer Registry (Funded by International Agency for Research on Cancer, Lyon, France)**

   Upto now the variable name has been entered for all incidence cases for the years 1985 onwards. The entry for the variables-name is to be carried out for all the incidence cases registered during 1964-1984. It is estimated that about the variable name is to be entered for about 1,00,000 cases. Data entry for the years 1964 to 1985 has been completed.

HOSPITAL & POPULATION BASED CANCER REGISTRIES, BANGALORE
Kidwai Memorial Institute of Oncology, Bangalore

Dr. K. Ramachandra Reddy, Dr. C. Ramesh & Mr. D.J. Jayaram

MEETINGS / TRAINING

1. Mr. U. Ramesh from Nizam's Institute of Medical Sciences, Hyderabad, was trained in the cancer registry operations for a period of 2 months from 16.8.05 to 15.10.05.

2. Dr. K. Ramachandra Reddy, Prof. & Head participated in the Pre-ARM Workshop and in the 21st Annual Review Meeting of the NCRP held at Kolkata from 9-12, November 2005 and presented the salient findings on the report of Bangalore PBCR and Mr. K.V. Krishna Reddy, Junior Biostatistician, presented the report in detail.

3. Dr. C. Ramesh, Assoc. Prof. delivered a talk on Case Control Study: Conduct, design and analysis in the workshop on Effective teaching of statistics for the college teachers of Bangalore University conducted by the Statistics Association of Christ College, Bangalore, on 13.1.2006.

4. Mr. K.V. Krishna Reddy, Junior Biostatistician, Mrs. B.J. Kumudini, Asst. Social Scientist, and Mr. C.S. Dayanand, Asst. Social Scientist participated in the Pre-ARM Workshop and in the 21st Annual Review Meeting of the NCRP held at Kolkata from 9-12, November 2005.

PROJECTS UNDERTAKEN/INVOLVEMENT OF REGISTRY STAFF

1. A project on 'Screening of all deaths irrespective of the cause of death all the Death Registration Units of Bangalore Urban Agglomeration for the improvement of cancer mortality data'.
   Principal Investigator – Dr. K. Ramachandra Reddy.
   Funded by: NCRP (ICMR).
   The project has started off and the duration of the project is 15 months.

2. Dr. K. Ramachandra Reddy, Co-Investigator for the project – 'Gene expression profiling of squamous cell carcinoma of oesophagus' – a joint project of KMIO and Institute of Bio-informatics, Bangalore.

3. Dr. K. Ramachandra Reddy, Co-Investigator for the project – 'Improved diagnosis of neoplasia in oral cavity using antibodies against mini chromosome maintenance proteins' – A collaborative project with MRC Cancer Cell Unit, Cambridge, UK.

4. Dr. K. Ramachandra Reddy, Co-Investigator for the project ' REGATE – REgistry of GAstric Cancer Treatment Evaluation' Joint project of KMIO and Aventis Pharma.

5. Dr. C. Ramesh, Co-Investigator for the project 'Folate status and Methelene Tetra-hydrofolate Reductase C677T gene polymorphism in childhood Acute Leukaemia' – submitted to the Department of Biotechnology, Government of India.

6. Dr. C. Ramesh, Co-Investigator for the project 'Impact of Methylene Tetrahydrofolate Reductase C677T polymorphism and Folate in Colorectal cancer – submitted to the Indian Council of Medical Research, New Delhi.

7. Dr. C. Ramesh, Co-Investigator for the project 'Human Papilloma Virus and Retino-blastoma ' – Submitted to the Indian Council of Medical Research, New Delhi.

HOSPITAL AND POPULATION BASED CANCER REGISTRIES
CANCER INSTITUTE (W/.I.A), CHENNAI 600 020

Principal Investigator	**Dr. V Santha**
Co-Investigator	**Dr. R Swaminathan**

ONGOING RESEARCH PROGRAMMES

1. Hospital Based Cancer Registry (HBCR):

The HBCR has been in existence since 1955 and is continuing to provide the required data to many research studies conducted in-house as well as by other academic institutions. Maintenance of medical records, abstraction of data in specific format, lifetime follow up of treated cases and providing statistics are the main functions of the HBCR.

Descriptive Statistics, Year 2005

Statistics for 2005	No. of cases
Cases seen	132,079
New registration	14,151
Follow up	117,928
Screening	501
Admissions	8,234
New Admission	3,643
Readmission	4,591
Cancer cases	8,950

Regionwise distribution of new registration	No. of cases	%
Chennai & suburbs	3,685	26.0
Rest of Tamil Nadu	6,420	45.4
Andhra Pradesh	3,150	22.2
Kerala	212	1.5
Assam	193	1.4
Rest of India	462	3.3
Outside India	29	0.2
Total	14,151	100.0

2. Madras Metropolitan Tumor Registry (MMTR)

The MMTR is a population based cancer registry (PBCR) involved in the systematic collection, compilation, analysis and reporting of data on incident cancer cases from Chennai City by active method since 1982. It is the first of its kind in the entire state of Tamil Nadu.

Analysis of data (of the year 2004) done in 2005*

	Male	Female	M+F
No. of incident cases	2,111	2,297	4,408
Male – Female Ratio	108 females to 100 males		
Crude incidence rate/10^5 population	91.7	103.4	97.4

* provisional figures

(3) **IARC project on "Estimation of survival rates of common cancers in HBCR, Cancer Institute (WIA), Chennai"- Principal Investigator: Dr.R.Swaminathan – A project under HBCR**

A total of 33,922 cases of common cancers (cervix, breast, head/neck, GIT, etc.) admitted for cancer directed treatment at the institute during 1985-1999 formed the basis. Data on 33,201 cases have been abstracted. Data entry is in progress.

(4) **IARC project on "Dindigul Ambilikkai Cancer Registry (DACR)"- Principal Investigator: Dr.R.Swaminathan**

DACR is the first PBCR covering predominantly rural area of the entire Dindigul district in Tamil Nadu. Its field office is based at the Christian Fellowship Community Health Centre (CFCHC), Ambilikkai, for operational convenience since 2nd August 2004. Its headquarter is situated in the cancer institute, Chennai. The sources of data collection are more than 100 and spread over ten districts of Tamil Nadu. The first report featuring cancer incidence and mortality in Dindigul district for the year 2003 has been published.

The DACR has now been entrusted with an additional responsibility of scientific evaluation of the cluster randomized cervical cancer field intervention trial that is currently underway in the area and the data management has been fully taken over by DACR. It is currently involved in the linkage of the registry and screening databases by house visits.

(5) **INCTR project on "A Retrospective Survey of Presentation features of Breast Cancer and Risk factors for Treatment Outcome" – A multicentric study, Principal Investigator: Mrs.R.Rama – A project under HBCR**

The objectives of the project are: (i) To create a data-base of information relating to patient characteristics, treatment and outcomes of breast cancer and (ii) to build capacity for cancer treatment and research through the development and augmentation of infrastructure for data management. The study material is a cohort of 3,893 treated cases of female breast cancer patients during 1993-2001 at the institute. The project envisages data abstraction using a questionnaire and online data entry. Pilot testing of data abstraction is completed. Data abstraction is in progress.

(6) **CI project on Population Based Hereditary Cancer Registry (PBHCR) – Principal Investigator: Dr.T.Rajkumar, Scientific Director, Cancer Institute (WIA), Co-Investigator: Dr.R.Swaminathan – A co-ordinating project with MMTR**

This is a continuing project since 2002 and is the only one of its kind in the country, till date. Data collection are being carried out by trained investigators on the lines of MMTR using a special proforma. Blood specimen is collected from cooperative patients with a family history of cancer on informed consent. The descriptive statistics for the year 2004 is as follows:

No. of cancer cases resident of Chennai registered in PBCR: 2,224 (cases interviewed: 2,050; only records perused: 174). No. of instances with a history of cancer in the family: 77 (3.5%)

(7) **Project on Population based screening for cancers of the cervix, breast and oral cavity in the Thiruvanmiyur belt area" – Principal Investigator: Dr.Rohini Premkumari, Professor of Radiation Oncology, Co-Investigator: Dr.R.Swaminathan – A project with MMTR**

The project is on to the fourth year of operation. Out of a total of 63,620 subjects of all ages in the area, 27,855 populations aged 30+ years were targeted and 8,481 subjects have attended the field clinic for clinical examination so far, yielding a compliance rate of 23.1% among males and 67.3% among females.

(8) **IARC project on Coimbatore District Cancer Registry (CDCR) - Principal investigator: Dr.R.Swaminathan**

CDCR is the second PBCR covering the entire district in the state of Tamil Nadu. The population covered is 4.2 millions comprising urban (including a Corporation) and rural areas. Its field office is based at the Christian Fellowship Community Health Centre (CFCHC), Ambilikkai, for operational convenience since 1st January 2006. The headquarter is situated at the Cancer Institute (WIA), Chennai. The sources of data collection are more than 50 at the moment and spread over ten districts of Tamil Nadu. The data collection pertains to the incident cancers diagnosed since 1st January 2005. Data on 1,999 cancer cases has been collected.

(9) **WHO project on Development of software for hospital based and population based cancer registries – Principal Investigator: Dr.R.Swaminathan – A project under HCR and MMTR**

This project attempts to integrate all the functions of HBCR and PBCR, separately, into one software that will contain a tutorial, manual, data entry, data checking, data analysis and standard reports. With this software, one or two trained persons will be able to handle cancer registration without requiring several people with expertise in different fields (like statistics, epidemiology, etc.). The intended users are the RCCs without HBCR and other major cancer centres in the private sector intending to start one. Work is in progress.

AWARDS

1. Dr. V.Shanta, Chairperson of the Cancer Institute (WIA), Chennai & Principal Investigator, Chennai PBCR and HBCR, was conferred the Ramon Magsaysay Award for public service for the year 2005

2. Dr.V.Shanta, Chairperson of the Cancer Institute (WIA) & Principal Investigator, Chennai PBCR and HBCR was conferred with the following distinguished awards:

    (i)   PADMABHUSHAN Award by the Government of India for outstanding contribution to medical sciences

    (ii)   Bahai Rose of Rivden Community Service Award by the Bahai Community

    (iii) Bharathi Award by the Vanavil Community Centre

    (iv)   Champion of Humanity Award by Hindustan Chamber of Commerce for pioneering work in paediatric cancer care, survey and early detection of cancer in rural areas

ORATION AND GUEST LECTURES

Dr.V.Shanta, Chairperson, Cancer Institute (WIA) & Principal Investigator, Chennai PBCR and HBCR, delivered the following oration/lectures on invitation:

(i) "Cancer Control: A Mission" – Ramon Magsaysay Foundation, Manila, Philippines, Aug-Sep 2005.

(ii) "Cancer Control – Where are we?" – Keynote address at the Indian Society of Oncology conference, Kidwai Memorial Institute of Oncology, Bangalore, August 2005.

(iii) "My encounter with cancer" – Keynote address at the Indian Academy of Sciences, New Delhi, November 2005.

(iv) "Convocation Address" – Bharathidasan University, Tiruchirapalli, November 2005.

(v) "Convocation Address" – Bangalore University, Bangalore, December 2005.

(vi) "Cancer Control" – ESTRO, Tata Memorial Hospital, Mumbai, February 2005.

(vii) "Evolution of Cancer Care" - AIIMS, New Delhi, February 2005.

(viii) "Locally Advanced Breast Cancer" – INCTR, Brussels, April 19, 2005.

(ix) "Cancer Awareness" – Rotary Meeting, Chennai, February 2005.

CONSULTANCY / FELLOWSHIP

1 Dr.R.Swaminathan offered consultancy services on data analysis and presentation of survival data from Izmir, Turkey, for presentation in an international conference. Ref: Eser S, Sankaranarayanan R, Swaminathan R, Yakut C and Ozalans. First Population based survival data from Turkey: Population based survival rate at IZMIR for selected cancers. IACR Annual Meeting, Kampala, Uganda, 2005

2 Ms. M. Kavitha attended the IARC Summer School on Cancer Epidemiology from 26th June – 14th July, 2006, at IARC, France. The courses included Introduction to Descriptive Epidemiology, Analytical Epidemiology and Molecular Epidemiology. She also had hands-on-training at the Screening Group, Pathogenesis and Prevention Cluster under the guidance of Dr. R. Sankaranarayanan during July 15-21, 2006.

TRAINING PROGRAMME CONDUCTED

1 Mr.Supot Kamsa-Ard, Statistician, Khon Kaen Cancer Registry, visited the department for an intensive training in survival analysis under the supervision of Dr.R.Swaminathan as part of the Calum-Muir Fellowship of International Association of Cancer Registries during November 16 – December 15, 2005.

2 Mr.Devi Prasad, Mr.Saravanan R, Mr.Maria Johnson J and Mr.Bob Willis, III B.Sc. Statistics students of Loyola College, Chennai underwent a two-week Industrial Interaction Internship Program between December 26 and January 13, 2006.

3 Ms.Ambily John, a student of Master of Social Work, St.Joseph's College, Devagiri, spent a one month block placement training in the department during May 1-31, 2006.

4 Twelve students of Master of Application Science in Medical Documentation of Mahatma Gandhi University, Kottayam, underwent an observation training in medical documentation in the department during October 6-22, 2005.

CONFERENCES/MEETINGS/WORKSHOP/COURSES ATTENDED

1   Dr. R.Swaminathan had an oral presentation titled "Cancer survival in developing countries: An overview" at the UICC World Cancer Congress, held at Washington DC, USA, during July 8-12, 2006.

2   Dr. R.Swaminathan, Ms. M.Kavitha and Mr.P.Sampath attended the National Conference on Recent Trends in Statistical Methodologies (NCRTSM-2006) held as part of the Golden Jubilee celebrations of the Presidency College, Chennai, during March 16-17, 2006.

3   Dr. R.Swaminathan was invited to deliver an address titled :Survival analysis: Recent approaches" at the National Seminar on Statistics, "Statistics: A lead to the facts", held at the Loyola College, Chennai, during February 13-14, 2006.

4   The NCRP XXI Annual Review Meeting and workshop held at CCWHRI, Kolkata, during November 11-14, 2005 was attended by the following:

Dr.R.Swaminathan – Principal Investigator, IARC DACR project, delivered the following lectures:

(a)   Cancer incidence and mortality in Chennai, India: Year 2002

(b)   Cancer incidence and mortality in Dindigul district: Year 2003

Mrs. R.Rama and Mrs.Joan of Arc from ICMR HCR project, Mr. P. Thangavel, Mr. T.S. Sambandam and Mr. M.Panneerselvam from MMTR project and Mr.A.Elumalai and Mr.P.Sampath from DACR project attended the meeting.

5   VI Annual Meeting of the International Network on Cancer Treatment and Research (INCTR), held in Chennai, India, during December 10-13, 2005 was attended by the following:

Mr. S. Devarajan, Systems Analyst, was the Principal author/Co-author for the following presentations:

(a)   Analysis of the Immunophenotypes of de novo Acute Lymphoblastic Leukemia in children and adolescents of the Indian subcontinent in relation to clinical symptoms and laboratory tests, preceding its diagnosis.

(b)   Improved outcome for acute lymphoblastic leukemia in children and adolescents: results of the MCP841 : a 20 years report from a developing country, India.

Dr.R.Swaminathan, Dr.Nalini, Mrs.Rama, Ms.Kavitha and Ms.P.Shanthi attended this meeting.

6   Mrs R. Rama, Statistical Assistant, presented a paper on "Covariate analysis of female breast cancers using survival models" in 23r^d Annual National conference of Indian Society for Medical Statistics (ISMS) held at Jawaharlal Nehru Medical College, Belgaum, from January 20-22 2006.

7   Ms M. Kavitha, Statistical Assistant, presented a paper on "A study of cancer cervix and female breast in India: Incidence, mortality and survival", 23rd Annual National conference of Indian Society for Medical Statistics (ISMS) held at Jawaharlal Nehru Medical College, Belgaum, from January 20-22, 2006.

8   Mr. P. Thangavel of MMTR and Mr. A.Elumalai of DACR attended the Annual Meeting of AROI Tamil Nadu Chapter, held at the Meenakshi Mission Hospital, Madurai, during September 3-4, 2005.

PUBLICATIONS / ABSTRACTS

1.   Nandakumar A and Swaminathan R Cancer incidence in south Asia. In: *UICC Handbook*. UICC World Cancer Congress, Washington DC, 2006.

2.   Sankaranarayanan R, Swaminathan R and Brenner H. Cancer survival in developing countries: An overview. Abstract. UICC World Cancer Congress, Washington DC, USA, 2006.

3.   Esmy PO, Rajkumar R, Swaminathan R, Cherian J and Sankaranarayanan R. Some preliminary observations from a randomized trial of cervical visual screening in Dindigul district in rural south India. Abstract. UICC World Cancer Congress, Washington

4.   Rama R, Shanta V, Venkatesan P and Swaminathan R. Covariate analysis of female breast cancers using survival models. *Abstract*, XXIII Annual National conference of Indian society for Medical Statistics (ISMS), Belgaum, 2006, pp 84.

5.   Kavitha M, Shanta V, Swaminathan R and Rama R. A study of cancer cervix and female breast in India: Incidence, mortality and survival. *Abstract*, XXIII Annual National conference of Indian society for Medical Statistics (ISMS), Belgaum, 2006, pp 104.

6.   Samson M, Rajkumar T, Swaminathan R, Sridevi V and Rama R. Genetic polymorphism and the risk of breast cancer. Abstract. UICC World Cancer Congress, Washington DC, 2006. 9-14.

7.   Devarajan S, Chandra A, Rajalekshmi KR and Sagar TG. Analysis of the immunophenotypes of de novo acute lymphoblastic leukaemia (all) in children and adolescents of the indian subcontinent in relation to clinical symptoms and laboratory tests, preceding its diagnosis. Abstract. INCTR Annual Meeting, Chennai, December 2005.

8.   Chandra A, Sagar TG and Devarajan S. Improved outcome for acute lymphoblastic leukemia (all) in children and adolescents: results of the mcp 841 (multi centre protocol): a 20 years report from a developing country (India). *Journal of Clinical Oncology 2006*; 24: 6586.

HOSPITAL BASED CANCER REGISTRY, THIRUVANANTHAPURAM

Regional Cancer Centre, Thiruvananthapuram

Principal Investigator	**Dr. B Rajan**
Officer-in charge	**Dr.Aleyamma Mathew**

ONGOING RESEARCH PROGRAMMES

1. Hospital-based cancer registry, Regional Cancer Centre, Thiruvananthapuram (Partially funded by: Indian Council of Medical Research, New Delhi).

2. Population-based cancer registry, Thiruvananthapuram taluk (urban and rural) (Partially funded by: Finnish Cancer Society, Finland).

3. Cancer Atlas in India (Funded by: National Cancer Registry Programme of India, Bangalore).

4. District Cancer Control Programme (DCCP) Thiruvananthapuram- Evaluation (Funded by: Government of India).

5. Pattern of care and survival studies on cancers of cervix, female breast and head and neck (Funded by: Indian Council of Medical Research, New Delhi).

6. Case-control study of breast cancer in South Asia comparing rural and urban women (Funded by: International Agency for Research on Cancer, Lyon, France).

7. Feasibility study for a prospective life-style and dietary cohort in Thiruvananthapuram.
   Part A: Logistics of conducting a cohort study; Part B: Detailed characterization of the Indian diet and Part C: Evaluation of follow-up and end-point ascertainment.
   (Funded by: National Cancer Institute, USA).

PUBLICATIONS

1. Indexed publications

1. JA Rusiecki, Aleyamma Mathew, Susan Sturgeon, Rashmi Sinha, E Pellizzari, T Zheng and Dalsu Baris. A correlation study of organochlorine levels in serum, breast adipose and gluteal adipose tissue among breast cancer cases in India, *Cancer Epidemiology Biomarkers and Prevention*, 2005; 14 (5): 1113-24.

2. B Binukumar, Aleyamma Mathew. Dietary and risk of breast cancer. World Journal of Surgical Oncology, 2005, 3: 45-58.

3. Aleyamma Mathew and B Rajan. Epidemiology and prevention of cancer in India. In Marsh RW and Samuel J (editors). The essentials of clinical oncology, Jaypee Brothers Medical Publishers (p) ltd., Haryana, 2005 pp: 42-60.

4. Prabha Balaram, SM Krishnan, S James, VT Cheriyan, ST Thankappan, Aleyamma Mathew. Epstein-Barr Virus downregulates expression of DNA-double strand break repair proeteins in nasopharyngeal cancer. Gene therapy and Molecular Biology, 2006; 10: 123-132.

5. MK Shakeel, B Binukumar, Aleyamma Mathew. Pesticides and breast cancer risk: A comparison between developed and developing countries, Nutrition and Cancer (Accepted for Publication, 2006).

6. B Binukumar and Aleyamma Mathew. Meat intake and risk of breast cancer, European Journal of Clinical Nutrition (Accepted for Publication, 2006).

2. Non-indexed publications

1. Aleyamma Mathew. Can cancer be made a notifiable disease? (editorial) In cancer registry Abstract, New letter Volume XII. National Cancer Registry Programme of India, Published by the Regional Cancer Centre, Thiruvananthapuram, 2005; pp: 1-5.

2. Ruma Bhattacharjee and Aleyamma Mathew. Comparison of incidence rates of leading cancers in the north east regions with that of population based cancer registries under the network of NCRP (ICMR). In cancer registry abstract, Newletter, Volume XII. National Cancer Registry Programme of India, Published by the Regional Cancer Centre, Thiruvananthapuram, 2005; pp: 12-21.

3. Aleyamma Mathew and B Vijayaprasad. Epidemiology of female breast and reproductive tract cancers in India. In cancer registry abstract, Newletter, Volume XII. National Cancer Registry Programme of India, Published by the Regional Cancer Centre, Thiruvananthapuram, 2005; pp: 22-31.

4. MC Kalavathy. Prevalence of tobacco habits in a coastal area in Thiruvananthapuram Corporation, Kerala, India, Abstract of 1st National Tobacco Control Conference, Mumbai, 2006.

5. MC Kalavathy. Prevalence of oral cancer in an urban coastal area of Thiruvananthapuram corporation, Kerala, India, ORCA 2006, Trivandrum, 2006.

6. MC Kalavathy. "Cancers among women" a report in 'Women's health in Kerala: Issues and challenges' – a workshop organized by Sakhi, Trivandrum, May 5th- 6th, 2006

3. Chapter in Monographs

1. Aleyamma Mathew. Cancer pattern in India. In Thomas G (ed), Handbook on cancer control, published by Kerala Health Services, February 2006.

2. Aleyamma Mathew. Challenges for statisticians in the Medical field, In Proceedings of the National Seminar on "Stochastic Process Modeling, Distribution Theory and Order Statistics, March 2006.

3. Aleyamma Mathew. Cancer Registration. In District Cancer Control Programme Thiruvananthapuram, Kerala, Action Plan, Published by the Regional Cancer Centre, Thiruvananthapuram, April 2006.

4. **Cancer Registry (Hospital and Population-Based) Reports Published**

    1. Hospital Based Cancer Registry, Regional Cancer Centre, Thiruvananthapuram, Annual Report for the year 2003, Published Regional Cancer Centre, Thiruvananthapuram in July 2006.

    2. Hospital Based Cancer Registry, Regional Cancer Centre, Thiruvananthapuram, Annual Report for the year 2004, Published Regional Cancer Centre, Thiruvananthapuram in October 2006.

5. **Newsletter CRAB**

    Cancer Registry Abstract, Newsletter, Volume XII, National Cancer Registry Programme of India, ICMR, Published by the Hospital-Based Cancer Registry, Thiruvananthapuram, October 2005.

CANCER REGISTRY/ EPIDEMIOLOGY TRAINING AND RESEARCH GUIDANCE PROVIDED

   1. One-year cancer registry training to Mr.Shiva Hari Sapkota, B.P Koirala Memorial Cancer Hospital, Nepal, 2005-2006.

   2. Mr. B Binukumar, Research Scholar in Bio-Statistics, Under the University of Kerala 2003-2006.

   3. One-day training in Epidemiology to 20 MSc. Bio-Statistics students, St.Thomas College, Pala on 21st December 2005.

CONFERENCES / WORKSHOPS ATTENDED AND PAPERS PRESENTED ETC.

   1. Aleyamma Mathew, 21st Annual review meeting & Pre ARM Workshop on Cancer Registry of National Cancer Registry Programme of ICMR. Papers Presented: "Population Based Cancer Survival" and "Population-Based Cancer Registry, Thiruvananthapuram- Methodology", Kolkata, November 9-12, 2005.

   2. Aleyamma Mathew, "Nutritional epidemiology and Cancer", One-day Seminar on Indian Nutritional Medical Association, Thiruvananthapuram, November 27, 2005.

   3. Aleyamma Mathew, "Life-style modifications in cancer risk reduction. Do they work?, International Symposium on Cardiovascular Diseases, Stroke and Diabetes, All India Institute of Medical Sciences, New Delhi, February 17-18, 2006.

   4. Aleyamma Mathew, "Challenges for Statisticians in Bio-medical field", National Seminar on Stochastic process modeling, distribution theory and order statistics, University of Kerala, Kariavattom, March 16-18, 2006.

   5. Aleyamma Mathew, "Basic Concepts in Research Methods and Data Analysis", National Programme in Developmental Neurology, Thiruvananthapuram August 27, 2006.

   6. MC Kalavathy, "Prevalence of tobacco habits in a coastal area in the city of Thiruvananthapuram, Kerala", First National Tobacco Control Conference, Mumbai January 27-29, 2006.

MERITS, AWARDS, FELLOWSHIPS

Dr. Aleyamma Mathew

1. **Chairman** of MSc. Biostatistics Core-Committee, Mahatma Gandhi University, Kottayam,
2. **Subject Expert** – Doctoral Programme in Epidemiology, Kerala University,
3. **Research Guide** in Epidemiology under the University of Kerala and Mahatma Gandhi University,
4. **Editor** of Cancer Registry Abstract, Newsletter of the National Cancer Registry Programme of Indian Council of Medical Research, India,
5. **Member**, Asia Cohort Consortium Meeting
6. **Research Review Committee Member,** Regional Cancer Centre, Thiruvananthapuram.
7. **Reviewer,** World Journal of Surgical Oncology, article reviewed (Profiles and Predictive factors in young age breast cancer patients) May 2006, and of Journal of Gastro Enterology & Hepatology (Article reviewed: Statistics for Clinicians: Survival Analysis) on January 2006.

Dr. Kalavathy M.C.

1. **Organizing Secretary,** Seminar on District Cancer Control Programme, 25th August 2006, Regional Cancer Centre Thiruvananthapuram.
2. Fellowship of National Cancer Institute, Bethesda, USA for attending the 'Summer curriculum in Cancer Prevention' offered by NCI, July-August, 2006

RETIREMENT

Mrs. V. Jalajakumari

Mrs. V. Jalajakumari retired from the services of Regional Cancer Centre, Thiruvananthapuram on 31st May 2006. She worked for 24 years in the cancer registry. She was mostly doing cancer registry data abstraction, coding and data processing.

CRAB records its sincere gratitude to Mrs. V. Jalajakumari for her dedicated work in the Cancer Registry. All staff of the HBCR,Thiruvananthapuram, wish her a prosperous life in the years to come.

POPULATION BASED CANCER REGISTRY, KOLKATA

Chittaranjan National Cancer Institute, Kolkata

Prof. Indira Chakraborty, Dr. Karabi Datta, Dr. S. Mandal, Dr. Soma Roychowdhury

Population Based Cancer Registry (PBCR), Kolkata, is one of the PBCRs in eastern India set up with active collaboration between Chittaranjan National Cancer Institute, Kolkata and Cancer Centre Welfare Home and Research Centre, Thakurpukur, Kolkata. It gets technical support from IARC. Since February 2005, PBCR Kolkata is being sponsored by ICMR. The report of PBCR during the period of 1997 to 2002 shows that the overall age adjusted incidence rates (AAR) are 106.7 per 100000 males and 114.6 per 100000 females. Among males the leading cancer sites are lung followed by oral cavity, pharynx, larynx and stomach. Among females the leading site is breast followed by cervix, gall bladder, ovary and lung. High incidence of breast cancer among females highlights the necessity of giving more emphasis on breast cancer screening programmes. The predominance of lung cancer in males emphasizes the importance of reducing tobacco habits by counseling, health education and legislative action.

Table 1. Incidence rates of all sites (1997- 2002)

Sex	Total Cases	Crude Rate	Age-Adjusted Rate
Male	17,930	86.3	106.7
Female	16,638	94.5	114.6

Table 2. Age Adjusted incidence rates of major sites (1997 & 2002)

Sites	1997	2002	Sites	1997	2002
Lung	13.5	19.3	Breast	21.7	28.3
Oral cavity	7.2	7.8	Cervix	24.2	17.1
Pharynx	8.3	7.1	Gall Bladder	6.0	8.5
Larynx	5.6	6.4	Ovary	4.9	8.2
Stomach	3.8	5.2	Lung	3.9	5.3

ONGOING STUDIES / PUBLICATIONS

1. Development of Cancer Atlas in India (Collaborators: NCRP, ICMR)
2. Death survey sponsored by IARC.
3. Case control study of Breast cancer in women of South Asia (Collaborator: Unit of Environmental Epidemiology, IARC, Lyon).
4. Mandal S, Ray K, Datta K: Evaluation of knowledge level regarding cancer among the population of a State of Eastern India. Journal of Cancer Education (Communicated).

MEETINGS ATTENDED

1. Dr. Karabi Datta, Scientific Officer and Dr. S. Mondal, Statistical Officer attended the workshop on "Development of an Atlas of Cancer in North East India" on second and third September, 2005 in NICED, Kolkata.

2. Dr. Karabi Datta, Scientific Officer and Dr. S. Mandal, Statistical Officer participated in XXI pre-annual and annual review meeting of National Cancer Registry Programme from 9th to 12th November, 2005 in Cancer Centre Welfare Home & Research Institute, Kolkata.

PRESENTATIONS

1. Dr. Karabi Datta presented a paper on PBCR data on 3rd September in NICED, Kolkata.

2. Dr. Karabi Datta and Dr. S.Mondal participated in pannel discussion on PBCR data collection and mortality data collection on 9th & 10th November, 2005 in Cancer Centre Welfare Home & Research Institute.

3. Dr. Karabi Datta presented a composite PBCR data from 1997 to 2002 on 11th November, 2005.

OTHER ACTIVITIES

1. The department organized the celebration of National Cancer Awareness day on 7th Novermber,2005.

2. Dr. Karabi Datta delivered a lecture on screening and prevention on cancer cervix in Chetla Urban Health centre, All India Institute of Hygeine & Public Health.

PUBLICATIONS

1. Cancer Pattern in Kolkata 1997-2001 Population Based Cancer Registry Report. *Chittaranjan National Cancer Institute Publication* 2005.

2. S Basak, S Mandal, TC Ghosh (2005): Correlations between genomic GC levels and optimal growth temperatures: some comments. Biochemical and Biophysical Research Communications. Vol. 327, No.4, pp.969-970.

3. RK Singh, S Dasgupta, N Bhattacharya, N Chunder, R Mondal, A Roy, S Mandal, S Roychowdhury, CK Panda (2005): Deletion in chromosome 11 and Bel-1/Cyclin D1 alterations are independently associated with the development of uterine cervical carcinoma. J. Cancer Res. Clin. Oncology. Vol. 131, No.6, pp.395-406.

4. MG Sabbir, A Roy, S Mandal, A Dam, S Roychowdhury, CK Panda (2006): Deletion mapping of chromosome 13q in head and neck squamous cell carcinoma in Indian patients: correlation with prognosis of the tumour. Int. J. Exp. Pathol. Vol. 87, No.2, pp.l51-161.

5. S Roychowdhury, Urmi Sen : Assessment of Awareness Level on Tobacco and Smoking Habit as a Risk Factor for Cancer among Lung & Laryngeal Cancer Patients Cancer in Kolkata. Asia Pacific Journal *-DL* Cancer Prevention, Vol-6, No.3, 2005, page 332-336.

6. N Sinha, Dhirendra and S Roychowdhury : Tobacco Control Practicles In 25 Schools Of West Bengal. Indian Journal Of Public Health, ISSN 0019- 557X, Vol- XXXXVIII, No.- 3, July -September, 2004.

POPULATION BASED CANCER REGISTRY, AHMEDABAD
The Gujarat Cancer & Research Institute (M.P. Shah Cancer Hospital), Ahmedabad

Principal Investigator   Dr. Pankaj M Shah
Co-Investigator(s)   Dr. Shilin N Shukla & Dr. Parimal J Jivarajani

The Population Based Rural Cancer Registry, Ahmedabad is functioning in the Department of Community Oncology and Medical Records. The registry data for the year 2004 are sent to Bangalore for analysis. For the year 2005, up till now a total of 749 cancer cases were collected from different sources.

Department has started work on Population Based Rural Cancer Registry for Ahmedabad Urban Area from January 2005. About 4000 caess are collected from different sources.

In the XXI Annual Review Meeting of National Cancer Registry Programme at Cancer Centre Welfare Home and Research Institute, Thakurpukur, Kolkata from 9-12 November 2005, on behalf of Dr. Pankaj M Shah, Hon. Director, Dr. Parimal J Jivarajani, Assistant Professor & Head of Department presented a report on the progress of the Rural Cancer Registry – Ahmedabad District for the year 2004. He requested that the PBCR for Ahmedabad Urban Area to be included in the NCRP network.

Regarding the XXII Annual Review Meeting, an invitation from the Gujarat Cancer and Research Institute had been accepted by the house and will be held on 15-18 November 2006.

MEETING / WORKSHOP ATTENDED
Dr. Parimal J Jivarajani, Assistant Professor, Ms. Ankita Shah, Biostatistician and Mr. Himanshu Patel, Field Investigator attended "Pre-Annual Review Meeting workshop" and "XXI Annual Review Meeting" of National Cancer Registry Programme held at Cancer Centre Welfare Home and Research Institute, Thakurpukur, Kolkatta from 9-12 November 2005.

MEETING ARRANGED
A meeting of Advisory Committee for Cancer Registry was organized by the department on December 5, 2005. Oncologists, Pathologists and Superintendents of different Government and Private Hospitals from the Ahmedabad District were invited. Dr. A. Nandakumar, Officer-in charge of National Cancer Registry Programme had chaired this meeting. Agenda of the meeting was to stress upon the importance and working pattern of the cancer registry along with the need to their cooperation for data collection.

ONGOING RESEARCH PROJECT
Development of Cancer Atlas in India (Collaborators: NCRP, ICMR & WHO).

PUBLIC SERVICE
Registry staff is actively involved in various cancer awareness activities (Mobile Exhibition, Early Detection Camp and Public Lecture) organized by the institute. In the year 2003-2004 our registry had participated in celebrating various events in the institute i.e. "Anti tobacco day", "Raksha Bandhan day", "Kite flying day", "Cancer victory day", "Tobacco Holi", "Hospital day", "Aarogya Yatra" etc.

POPULATION BASED CANCER REGISTRY, SIKKIM
STNM Hospital, Gangtok, 737101

Principal Investigator	**Dr. Yogesh Verma**
Co-Investigator	**Dr. Prakash Pradhan**

Population Based Cancer Registry was initiated in the year 2003. The Population Based Cancer Registry has presently one Research Officer, two Social Investigators and one Computer Programmer. Apart from this two more ICMR projects namely 1) Cancer in North-East India: Understanding the Role of Tobacco and 2) Cancer in North-East India: Understanding the Role of Pesticide. This two are multi centre Research Projects and ha begun only in April 2005. Blood, urine and tissue samples are being sent to the various designated laboratories. Both these projects have separate staff.

TRAINING AND MEETING ATTENDED

1) P.I and three staff attended the Pre-ARM and ARM of NCRP at Kolkata in the month of November 2005.

2) P.I was the resource person at the Cervical Cancer Prevention in North East India from May 26th to 28th 2006 held at Gangtok by the Cancer Foundation of India.

3) The PI was awarded Calum Muir fellowship by the International Association of Cancer Registries. He attended the Thames Cancer Registry Kings College London from the 29th of May to 23rd of June 2006. During this fellowship he visited the Cambridge, Oxford and Scottish Cancer Registries

4) Mr. Saroj Deep Sapkota, Computer Programmer attended the three days training programme on North East Data Entry Software for PBCR at Bangalore in the end of May 2006.

5) P.I attended one day workshop at Kolkata on the Development of Atlas in India in North East region on 2nd and 3rd Sept. 2005.

Name of the staff in PBCR

1)	Dr. Rachana Lamichaney	Research Officer
2)	Mr. Saroj Deep Sapkota	Computer Programmer
3)	Mr. Prakash Sundas	Social Investigator
4)	Mr. Pranay Giri	Social Investigator

Name of the staff in Cancer in North-East India: Understanding the Role of Tobacco

1)	Ms. Tshering Dolma Zongtenpa	Lab. Technician
2)	Mr. B.N Bhattarai	Social Investigator

Name of the staff in Cancer in North-East India: Understanding the Role of Pesticide

1)	Mrs. Daisy Lamichaney	Lab. Technician

POPULATION BASED CANCER REGISTRY, GUWAHATI

Dr. B. Borooah Cancer Institute, Guwahati-16, Assam

Principal Investigator   **Dr. J.D. Sharma**

ONGOING PROJECTS

1. ICMR-project-Understanding Cancer in North-East, Role of Tobacco and Pesticides. ICMR-project-on Carcinoma Oesophagus (multicentric study).

2. Development of an Atlas of Cancer in North-India in Department of Pathology of Dr. B. Borooah Cancer Institute, Guwahati-16, Assam.

PAPERS PRESENTED

1. Gimpse at pattern of cancer in Assam, (annual conference of Radiation Oncologists of Eastern India,September 2005, Guwahati)

2. Glimpse at pattern of Head and Neck Cancer in North-East (First conference of Association of Oncologists of North East India, April 2006, Guwahati).

3. PBCR and its working methodology (in annual meet of Guwahati Forum of Pathologists a branch of North East Regional Chapter of IAPM, November 2005).

POPULATION BASED CANCER REGISTRY, MANIPUR
Regional Institute of Medical Sciences (RIMS), Imphal

Principal Investigator   Dr. Y.Mohen Singh, Prof & Head, Dept. of Pathology

Co- Principal Investigator   Dr.Kaushik Debnath, Prof. Dept. of Pathology

The Population Based Cancer Registry (PBCR), Manipur is functioning in the Department of Pathology, RIMS, Imphal since January 2003. At the beginning of the programme, it covered Imphal west district only with an area of 519 sq. km. and an estimated population of 4,39,532. Beginning of January 2005 its operation has been expanded to cover the entire state with an area of 22,327 sq. km. and a total population of 22,93,896 (2001 Census).

Table 1. Incidence of Cancer

Year (Coverage)	Male	Female	Total
2003–04 (Imphal west)	304	370	674
2005 (Entire State)	521	617	1138

Table 2. Top five sites of cancer, 2003–04

MALE	No.	%	FEMALE	No.	%
1. Lungs	64	21.1	Lung	60	16.2
2. Stomach	26	8.6	Cervix	55	14.9
3. Oesophagus	22	7.2	Breast	54	14.6
4. Leukaemia	19	6.3	Thyroid	20	5.4
5. Nasopharynx	17	5.6	Leukaemia	18	4.9
6. Others	156	51.3	Others	163	44.1
Total	304	100		370	100

Table 3. Top five sites of cancer, 2005

MALE	No.	%	FEMALE	No.	%
1. Lungs	116	22.3	Lung	104	16.9
2. Stomach	45	8.6	Cervix	87	14.1
3. Nasopharynx	32	6.1	Breast	67	10.9
4. Leukaemia	31	6.0	Gall Bladder	44	7.1
5. Oesophagus	26	5.0	Ovary	30	4.9
6. Others	271	52.0	Others	285	46.2
Total	521	100		617	100

Table 4. Cancer incidence rates in Imphal (2003-04, 2005).

Rate	2003-04		2005	
	Male	Female	Male	Female
Crude Rate	65.7	79.2	44.3	53.0
Age-adjusted Rate	87.0	93.9	66.8	83.1
Truncate Rate (35-64 yrs)	143.3	186.2	109.1	151.5
Cumulative Rate	13.4	12.5	10.6	12.1
Cumulative Risk	12.5	11.8	10.1	11.4

MEETINGS, TRAINING PROGRAMMES AND WORKSHOPS ATTENDED (2005 – 06).

1.   Pre ARM and ARM (Annual review meeting), Thakurpukur, Kolkotta. 9 -12 Nov, 2005.

2.   Press Meet on the working of PBCR Imphal and its impact on cancer awareness in Manipur, 25th July 2005.

3.   Organisation of Cancer Screening camp at the Indo-Myanmar border town of Moreh, 8th 9th October 2005.

4.   Computer programmer participated in a training programme on data entry and management at Bangalore, 15th – 17th May, 2006.

Staff, PBCR Imphal

1. Dr. H. Satyajyoti   Medical Research Officer
2. Dr. O. Bijaya Devi   Statistician
3. Mr. R.K. Budhibanta   Computer Programmer
4. Mr. L. Bhopendro   Social Investigator
5. Mr. K.H. Nabachandra   Social Investigator
6. Mr. M. Surjit Meitei   Social Investigator