Chapter 2

Literature review

2.1 Introduction

This chapter deals with the researches which have been already done and also review the present research trend in Medical Geography. The term ‘medical geography’ was first used by a physician named Leonhard Ludwig Finke in the late 18th century (Barrett, 1980), though the genesis of the idea is traced to the time of Hippocrates. In his famous book ‘Air, water and places’ he studied the relationship between health and environment in 400 B.C. As per August Hirsch, Hippocrates’ work remained the only attempt which initiated philosophical treatment of geographical facts (Barrett, 2000). Besides, the usage of the term ‘medical geography’ to describe the spatial distribution of disease is found in Leonhard Ludwig Finke’s ‘Versuch einer allegemeinen medicinish-praktischen Geographie’ published in 1792. He made an attempt to describe a broad topography of disease and also argued for a relationship between diseases and potential treatments as outcomes of local environmental factors affecting specific populations (Koch, 2005). With the concretization of the sub-discipline, medical geography is made to answer following major six questions (Meade, et al., 1988):

1. Why is a phenomenon distributed in a particular way?
2. Why are facilities and businesses located where they are? Why are the offices of physicians, public clinics, or research hospitals located in certain places and not in others?
3. Why do people move in certain directions for certain distances?
4. Why do innovations (including ideas and material goods) spread as they do?
5. Why do people vary in perception of the environment?
6. How do objects, ideas, processes, and living beings interact to characterize and constitute places?

Medical geography is essentially bifurcated into Geography of disease and the Geography of health care. Geography of disease or ill health describes disease frequency, illness occurrence, relationship between illness and associated environmental factors in respect of answering the three major questions of geography i.e. who, why and where. Whereas, the Geography of health care describes the facility location, accessibility and utilization, patient
behaviour patterns from the spatial vantage point (Litva & Eyles, 1995). Parr (2003) classified medical geographical research into two dimension: research work on the spatial distribution of disease and death and geographical complexities surrounding the provision, access to and (in) equality of health care. Mishra (2007) further expands the idea include four perspectives of viewing Medical geography. First, it focuses on pattern of health and ill-health on space. Second, it studies the intensity and frequency of the health problem and various natural and socio-economic factors that determine the health condition. Third, it identifies causes and risk factors of health and ill-health by etiological hypotheses testing. And fourth, medical geography examines the spatial distribution of health care facilities with a view of suggesting policies, programmes and methodologies for locating them optimally and in conformity with the current and future needs.

In the colonial era when Europeans discovered many new lands, the rapid growth of medical geography took place. Because various diseases like plague, cholera, smallpox, tuberculosis, sexually transmitted diseases travelled from one place to another and thus the globalization of diseases took place. However, the growth of research studies in medical geography lost its pace due to the path breaking and historic feat of inventing the germ theory by Louis Pasteur in 1861. The theory gave importance on identifying the responsible germ of a disease and accordingly administers medicines that killed them. But the germ theory was criticized for simplifying the complex were factors that caused diseases. Numbers of persons inhabiting a same region are not equally influenced by the germ due to differences in cultural practices, level of nutrition and individual attitudes. Hence, it may be concluded that only identification of germ as per the biomedical disease model, is not enough to prevent diseases rather researchers should pay more attention to evaluating the socio-ecological model which identifies the impact of different geographical factors namely physical and socio-cultural factors on health (White, 1981). The socio-ecological perspective believes in advanced identification and prevention of diseases rather than its treatment (Rootman & Munson, 1990). Besides availability and accessibility of health care facilities various socio-economic factors like income, household wealth, education, and living style are strong factors of healthy well-being (Kandel, 2004).

Recent medical geography research studies are being done on utilization pattern of health care facilities (Russo, et al., 1997; Somkotra, 2010; Mohanty and Srivastava, 2013; Ghosh, 2014), facility allocation model development (Verter, 2002; Mitropoulos et al., 2006; Hodgson & Jacobsen, 2009; Gu et al., 2010) in different geographical scale. Application of
spatial statistical techniques and models play an important role to study health related issues. Spatially explicit modelling was used to delineate malaria prone area in eastern Africa (Kienberger and Hagenlocher, 2014). Relative risk mapping and scan test statistics were applied to find out the incidence variation of Notifiable Gastrointestinal Illness (NGI) in north-west territories of Canada from the spatial and temporal perspectives (Ali et al., 2012). Many of researchers found Bayesian spatial model as useful technique for the preparation of disease maps and to study health-environmental association (Abellan et al., 2008; MacNab et al., 2004; Colonna, 2004). Hampton et al. (2011) found Uniform Model Extension of Bayesian Maximum Entropy (UMBME) and ordinary kriging methods as important geospatial techniques to analyze spatial variability of disease. Medical geography was benefitted from the sophisticated computing trends during 1960’s which percolated a bit late in India. Invention of computer, various modern instrument and software especially Remote Sensing, Geographical Information System (GIS), Global Positioning System (GPS), and different statistical packages have reinvigorated the sub-discipline altogether (Askari & Gupta, 2013). Armstrong (1972) has also considered the use of computer technology for the preparation of data for mapping as a promising development for medical geography. GIS techniques adorn an important place with regard to its capability to plan for future medical service provision and allocation of facilities in different locations (Rosenberg and Wilson, 2005).

Medical geography is becoming popular among social scientists like medical sociologists, cultural anthropologist, social psychologist, among others (Table 1.1), who have relied heavily upon principles of spatial analysis (Pyle, 1976).

Table 2.1 Social science contribution to medical geography

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>Evolution of the major medical systems, changes in illness prevalence and treatment modes, awareness of historical inertia</td>
</tr>
<tr>
<td>Political science</td>
<td>Impact of type of medical system, role of public and private power-wielding groups</td>
</tr>
<tr>
<td>Economics</td>
<td>Medical costs and cost-benefit analysis, private and public payment plans, health care and economic development</td>
</tr>
<tr>
<td>Anthropology/sociology</td>
<td>Beliefs about illness causes and effective treatments, characteristics of patients and practitioners, patient-practitioners relationships</td>
</tr>
</tbody>
</table>

Source: Meade, et al., 1988
The purpose of this chapter is to review literatures within the framework of the present study. Reviewed literatures have been divided by some sections, which will cover the whole content of the study. Spatial distribution as well as disease epidemiology will be reviewed in first section. Second section deals with the accessibility and availability of health care facilities. Study related to domestic environment and occurrence of diseases will be reviewed in third section. Fourth section reviews the utilization pattern of health care facilities addition to its socio-economic determinants.

2.2 Spatial Distribution of Diseases

One of the important purposes of the study is to describe spatial distribution of diseases because ‘there are large geographical variations in the incidence of diseases’ (Howe, 1964). The discussion about disease ecology and epidemiology is not new in medical geography, which was emerged with the famous book ‘Air, Water and Place’ by Hippocrates in 400 B.C. deals with the influence of environment on health. In second half of nineteenth century, many books were published on medical geography among them almost every books ware about history of diseases, particularly epidemic diseases. Disease arises with the convergence at certain point in time and space of two orders of factors: Pathological factors which are called ‘Pathogenes’ and geographical factors which are called ‘Geogens’. Studies of Pathogens are common in medical study but Geogens are in medical geography. Medical geographers discuss the relationship between health and geogens that mean geographical factors which consists physical and cultural environment.

Medical cartography has contributed substantially in the development of medical geography being fuelled heavily by an underlying belief of the discipline that if it can’t be mapped, it is not geography. Disease distribution and diffusion mapping is one of the important contents of medical geography forever (Kearns, 1995). Adding to it, Learmonth (1968) argued that cartographic map interpretation may differ from a small to a large scale map. Various statistical techniques are used in geography like in other disciplines, but preparation of maps is a distinctive tool for analysis of geographical phenomena (Meade et al., 1988). Apparently the first such map was produced by Dr. Valentine Seaman in his treatise on yellow fever in New York City in 1798 (Meade et al., 1988). For the first time maps related to health issue were included in an atlas by Heinrich Berghaus in his ‘Physikalischer atlas’ in 1852 to show
the distribution of a variety of epidemic and endemic diseases. Another such work was done by John Snow in 1854 which is considered as the pioneer work depicted relationship between place and disease. He prepared a map and found water pump responsible for the cholera epidemic in the Golden Square district of London. Based on the findings Snow concluded that cholera as water borne disease, long before the invention of bacteriology (Park, 2013). American Geographical Society published the ‘Atlas of Diseases’ in three volumes under the guidance of Dr. Jacques May in the year 1958 and 1961. The Royal Geographical Society of U.K. published the ‘National Atlas of Disease Mortality’ in 1963 under the editorship of G. Melvin Howe (Mishra, 2007).

Stomach cancer mortality distribution in South Africa was highlighted by McGlashan (1972). The author used registered medically certified causes of death among all the white population of the Republic South Africa from 1949 to 1958 recorded by Bureau of Census and statistics in Pretoria. In this analysis they have prepared lots of maps to show the picture of epidemic of diseases in that area.

Hadjichristodoulou et al. (1998) used case control method to find the efficiency of health education to reduce the brucellosis disease in a rural area, Fokida of Greece, which is long term active surveillance from 1989 to 1993. They selected rural area of Grevena as a control area. For this study three suspected brucellosis free zones were identified and two of them were successfully protected. The target of the study was estimated at 1.4/1000/year for the study area and 1.6/1000/year for the control area. The result during surveillance period shown the study area decreased 0.2/1000/year and the rate was 1.0/1000/year in the control area. The study also found health education act as one of the efficient factor to prevent the occurrence of the disease.

To point out the cancer mortality distribution in Western Europe, Rosenberg et al. (1999) used spatial auto-correlation (SA) analysis to find spatial pattern of mortality. For this purpose they have analyzed 355 registration areas. The result of the analysis shows cancer mortality distribution was homogenous in nature with higher concentration in Denmerk and low mortality rate in southern Italy, whereas Ireland compromised heterogeneous pattern.

With the help of cancer incidence data, which were collected from the Isere cancer registry (France) over the period of 1985-1994, Colonna (2004) investigated the relative risk of cancer disease by using Bayesian approach, spatial auto correlation and heterogeneity tests.
Thomas et al. (2008) investigated the trend of diabetes mellitus (type 1) incidence among 2644 Australian children aged 0-14 years between 1989 and 2005. The paper also made an attempt to find the relationship between the disease and population density by applying Bayesian hierarchical models. The study found higher concentration of the incidence in rural areas as well as eastern part of Australia.

Dengue fever is considered as a significant burden of tropical developing countries. Chang et al. (2009) analyzed the responsible factors of occurrence of dengue fever by combining Google Earth and GIS maps. Firstly, they have identified areas having standing water, dumps locality from Google earth map and those areas are characterized as Bluefield area on the map. Then dengue prone areas have been overlaid on the map.

Notifiable Gastrointestinal Illness (NGI) in the North-west Territories (NWT) of Canada was studied from the spatial and temporal point of view. Relative risk mapping and scan test statistics were applied to describe the variation of disease risk and cluster analysis. Ali et al. (2012) found south region are more NGI prone as compare to north region and the rate of illness fluctuated from year to year. Another study shows the cancer incidence is very common in Sudan and cancer ranked as the major cause of death. Elebead et al. (2012) produced base maps for implementation of cancer control programme in Geziria, Sudan. They have also prepared cancer density maps to show spatial distribution with the help of Geographical Information System. In this study they have used cancer cases data registered from 1999 to 2008, by the Institute of Nuclear Medicine; Molecular Biology and treatment of Tumors of University of Gezira in El Gezira.

Samat and Percy (2012) mentioned in their paper that most articles involve exploratory analysis to describe spatial distribution of diseases and also use geographical information systems to integrate patient related information. In their paper they have followed a different way to analyze dengue disease in Malaysia. The authors introduced an alternative method to estimate the relative risk of dengue disease transmission based on discrete-time, discrete-space, and stochastic-SIR-SI (Susceptible-infective-recovered for human populations; Susceptible-infective for vector population) models using classical approach based on standardized morbidity ratios (SMRs).

Spatially explicit model was used by Kienberger and Hagenlocher (2014) to delineate malaria prone area in Eastern Africa, which carried the homogenous social vulnerability. They have found population of highlands with low immunity power; regions with low
accessibility to education and health are more vulnerable as compared to those who have low poverty, low population pressure, low conflict density. Liu et al. (2014) also described the spatial distribution of dengue fever in Gangdong Province, which is the most vulnerable area in China. In this study dengue incidence data was used from 2001-2006 for the preparation of map to show crude incidence, excess hazard and smoothed incidence by using GIS technique and spatial scan cluster analysis. The result suggested that areas around Guangzhou city and Chaoshem region were most vulnerable for the occurrence of dengue fever.

### 2.3 Spatial distribution of health care facilities

Access to medical services is one of the basic necessities of any modern human community. It is a major complement to a strong, progressive and dynamic society. The lack of infrastructures has led to insufficiency in good health as well as in production and development of a society. But there is inequality in distribution of health care facilities in different area. Hence, health care geography is very important because it helps to find out the area with insufficient health care facilities in addition to present and required condition. According to White (1979) to observe the location pattern in urban area, the interaction and linkages between health services should be discussed. To demonstrate the different degree of facility concentration the author used spatial pattern analysis technique like nearest neighbour analysis. For the aggregate arrangements of public service facilities in each study area chi-square goodness of fit test was applied.

Health seeking pattern varies from one place to another, lots of factor may be responsible for the variation. Kushman and Patricia (1987) used an exponential spatial interaction model to analyze primary health care seeking pattern in rural consumers in northern California. In this study some limitations have been found, for example this model is suitable for those areas where the consumer characteristics are fairly homogenous in nature. However, the model developed in this study to get some of the demand side data needed for analyzing primary health care delivery system.

Jappelli and Padula (2003) highlighted the relationship between the quality of health care and the health outcomes. Their study consists seven section based on 2000 sample older than
50 in Italy. After introduction, section 2 describes the main features of the Italian National Health System. Information on health status, medical expenditure and utilization pattern of health facilities have been described in section 3. Next section addresses measurement issue and section 5 portrays the relationship between health status and health risk factors like smoking, drinking, physical activities. Section 6 shows, improvement in the quality of health care can shed positive impact on health outcomes and also supports that inequality in health care quality produce health disparities. The concluding chapter also provides further evidence to support the findings based on the Survey of Household Income and Wealth (SHIW) conducted from 1993-1995.

The health care utilization pattern may be influenced by accessibility of the health care facilities. Gage and Lalixte (2006) concluded that deliveries by trained medical personnel as well institutional delivery are significantly reduced in mountainous terrain and also in distant area. They suggested in their paper that investment in community infrastructure including road transportation networks may provide more accessible health facility. The paper highlighted the negative relation between poverty and health care utilization pattern.

It is very difficult to quantify adequate availability of health services to a population group. The ratio analysis like doctors per population, population served by a facility etc. does not include the service area of the facility. Spencer and Angeles (2007) used Kernel Density Estimation (KDE) within Geographical Information System to represent the spread of people and services across the Nicaragua. A buffer zone map and other maps by calculating population density with three different Kernel size have been drawn in the paper to show the accessibility of health care facilities in the said area.

Accessibility of health care facilities may vary among various age cohorts, because older peoples have lower mobility level. Paez et al. (2010) have made an attempt to find out the accessibility pattern by considering average trip length to the available facility in Montreal Island. For this purpose travel behaviour data, average trip length, relevant traveller’s attributes data were collected from Montreal Household Travel Survey. The result found, there is relatively less mobility among older aged people compared to other age cohort. The result also supported that there is large disparities in accessibility between urban and sub-urban seniors and in between of vehicle owning and non-owing seniors.
An attempt has been made by Purahit (2010) to analyze the efficiency variation of the health care system in Karnataka. For this purpose the author used the stochastic frontier technique. After the analysis the result shown that the efficiency of public health delivery system remains low, which shed negative impact on improving the life expectancy in the state. This paper suggested that by overcoming from this problem and improvement of adequate infrastructure like safe drinking water supply, proper sanitation and electricity to improve the health outcomes.

Delamater et al. (2012) mentioned in their paper that inequalities in geographical accessibility of health care facilities may be influenced by configuration of facilities, population distribution and transportation. For this study they have reviewed conceptual and practical differences between raster and network data models. The intention of the paper was to investigate limited access area. Identifying the number of people residing more than 30 minutes from an acute care hospital was the main calculation tool to find out geographical accessibility. The study shows areas having limited accessibility were similar in their location, configuration and shape.

The two step floating catchment area (2 SFCA) method was used to measure spatial accessibility of health care facilities in Victoria, Australia. In his paper McGrail (2012) presents the first comparison between continuous and zonal (step) decay functions of effectiveness of various facilities especially within both rural and metropolitan region. Munoz and Kallestal (2012) supported that the role of primary health care is very essential to improve the quality of health because PHC act as the first level of contact, by which individuals, any family and any community can easily connect with the national health system. To measure geographical accessibility they have taken three different travel scenario, these are i) walking ii) walking and cycling and iii) walking and public transportation used by people to attend nearest primary health facility and found scenario- ii (walking and cycling) has the highest degree of geographical accessibility. By using modern geographical information system (GIS) techniques they have concluded that there are significant spatial variations in geographical accessibility across the three scenarios.
2.4 Domestic environment and occurrence of diseases
Domestic environment is one of the important factors of health wellbeing. Domestic environment compromises living style, occupation, activity in the house, living environment, individual relationship with other family members as well as other socio-economic condition like family income, literacy rate, age, number of family member etc. Peoples spend maximum time with their family in the same house, so there is strong relationship between health condition and domestic environment. The main aim of this section is to review some existing literatures, which have discussed the relation.

Zhang et al. (2006) studied the relation between domestic environment and occurrence of Eczema and Itchy Rash in Perth. A total of 996 children aged 4-12 years were taken from primary school for the study purpose. After analyzing the collected data with the help of logistic regression coefficient and chi-square test, they found a relationship. For the study they considered age and gender of the child, parent’s history of eczema, education status of mother, age of dwelling, type of winter heating, type of summer cooling, carpet used in child’s bedroom, perception of general ventilation, passive smoking, type of cooking etc.

The magnitude and risk factors for domestic violence during pregnancy shed negative impact in Nigeria. Iliyasu et al. (2012) considered domestic violence as a hazard of pregnant women. By investigating 400 pregnant women they concluded domestic violence may lead the pregnant women to serious injury, death, psychological disturbance and deprivation etc. The study was conducted among pregnant women attending antenatal care at AKT hospital in Kano, Nigeria. They also suggested that pregnant women seeks preventive, protective domestic environment.

Ceballo et al. (2004) considered domestic violence as a global problem. They highlighted the occurrence of psychological problem due to domestic abuse among women in a semi-industrial country in Chile. For this purpose they selected 215 mothers residing in working class communities located on the out skirts of Santiago. The analysis found poverty and other structural inequalities are responsible for domestic abuse. The study considered that stressful life events have direct relation to domestic conflict and such domestic violence affects women’s mental health with higher possibilities in case of greater domestic conflict.

Redmond et al. (2009) reviewed the association of health hazards with domestic kitchen. The paper considered domestic kitchen as ‘front line in the battle against food borne
disease’. The study revealed kitchen often contaminated by various harmful microorganisms like campylobacter, salmonella which shed negative impact on human health.

Poor indoor air quality (IAQ) seriously affects on health in Swedish schools. Alsmo and Holmberg (2007) studied various disease occurrence like irritation of eyes, nose and neck; dry mucous membranes; skin rashes; tiredness; headache etc. are associated with poor indoor air quality which may be described as Sick Building Syndrome (SBS).

2.5 Utilization pattern of health care facilities

The decision to choose health care facility during illness may be influenced by several factors such as cost and quality of health care; the level of household income; the patient’s health status and household characteristics which includes age, sex, education etc. Health care utilization pattern may vary in different region, it may be for cultural differentiation; variation in socio-economic condition or due to physical factors. Many researchers have done their study to investigate the utilization pattern.

Stratmann et al. (1975) analyzed public attitude towards health care. The paper based on primary household survey which compromises total 521 sample household. The intention of the study was to answer some question like who should control the delivery of health care, how the cost of health care are perceived, or how the delivery of care should be financed. Another work by Fylkesnes (1993) who studied the controlling factors those affect the general practitioners (GP) visits and the rate of outpatient seeking for treatment and hospitalization. The analysis was done with the help of regression models based on a set of data acquired from population study including 3533 men and 3578 women aged 40-42 in a county of Northern Norway. The findings of the study revealed that GP per population, socio-demographic characteristics and social network act as important controlling factors. The study also found biasness in rate of referral of patients which is higher in case of those groups having higher status.

Buor (2002) has supported the inverse relationship between distance and the use of health services. With the help of formal interview schedules he has drawn 250 samples by systematic random and stratified procedure in Kumasi metropolis in Ghana. Beside the distance factor, travel time, transport cost, various socio-economic characteristics of human being are also important determinants of health care utilization pattern.
Tang et al. (2013) found regional differences in maternal health care utilization in China. For this study they have considered four Maternal Health Care (MHC) utilization indicators namely Early Examination Rate (EER) which included 13 weeks within pregnancy, Prenatal Examination Rate (PER), Hospital Delivery Rate (HDR) and Postnatal Visit Rate (PVR). Index of dissimilarity was used as a statistical technique to show the regional discrepancies and geographical mapping was done to portrait the regional disparity.

With the help of two stages of cluster sampling household interviews on 7939 individuals in 988 households were done by Dong et al. (2006) to find out the characteristics of different health care users by using a health demand model. The other objective of the study was to gauge the probable price change for different types of health care system in Burkina Faso. The result found two third of sample populations were non-user of health care facilities, among them maximum were belonging from lower family income and expenditure group as well as older group. The main reason for their non using behavior was low income.

By analyzing the District Level Household Survey (2007-2008) data Mohanty and Srivastava (2012) investigated the cost of hospital based delivery care and its utilization pattern in the Empowered Action Group (EAG) states of India. Multivariate analysis of this paper shows that the utilization of delivery based health care facilities is influenced by time, place of residence, economic status, educational attainment, delivery characteristics of mother etc. The paper also describes the relationship between the governmental expenditure in health sector and the change of utilization pattern of public and private health care facilities.

Akbari et al. (2009) estimated a health care demand model to examine the outpatient visit pattern to government hospitals from the year 1989 to 2006 in Pakistan. The study included various variables like per capita government hospitals, doctor visit at a private clinic, per capita income, the average price of medicine as important determinants of outpatient visit to government hospitals. The level of significance of said variables vary in different provinces and this type of variation determined by cultural, social and religious factors.