

# Links Between the Epidemiology and Control of Noncommunicable Diseases and Neglected Tropical Diseases in Asia



Tarun Bhatnagar, Prabhdeep Kaur, and Vasanthapuram Kumaraswami

## Contents

1	Background .....	150
1.1	Disease Burden of NTDs and NCDs .....	150
2	Economic Burden of NTDs and NCDs .....	154
3	NTDs as Risk Factor for NCDs .....	157
3.1	Social Determinants and Consequences of NCDs and NTDs .....	157
3.2	Psychosocial Determinants and Consequences of NCDs and NTDs .....	159
3.3	Interventions for NTD and NCD Control: Learning from Experiences in the Region ..	160
3.4	Strategies, Policies, and Programmes for NCD and NTD Control .....	161
3.5	Service Delivery Using Primary Care Approach .....	163
3.6	Human Resources for Service Delivery .....	164
4	Drugs for the Management of NTDs and NCDs .....	165
4.1	Community Involvement and Community-Based Interventions .....	166
4.2	Challenges and Opportunities .....	168
	References .....	168

**Abstract** The Southeast Asian region is undergoing an epidemiological transition with a double burden of communicable and noncommunicable diseases (NCDs). The region accounts for a high share of both neglected tropical diseases (NTDs) and NCDs at the global level. Chronicity of both diseases, high prevalence of risk behaviours, and parallel health system issues along with similar affected populations provide a unique setting for rationalization of health interventions for the control of NTDs in the region.

**Keywords** Asia · Burden · Community-based · Determinants · Health services · Noncommunicable diseases · Neglected tropical diseases

---

T. Bhatnagar (✉) · P. Kaur · V. Kumaraswami  
ICMR-National Institute of Epidemiology, Chennai, India

## 1 Background

Southeast Asia is home to more than half of the world's population (Nations Online Project 2014). Nearly 45% of the world's poor also live in the Southeast Asia region (Dhillon et al. 2012). Southeast Asia accounts for nearly one fourth of the global soil-transmitted helminth infections, one third of all rabies deaths, and more than half of the global burden of lymphatic filariasis, visceral leishmaniasis, and leprosy. Other Neglected Tropical Diseases (NTDs), such as dengue fever, are emerging (Lobo et al. 2011). In addition, the region is going through an epidemiological transition reflected by a double burden of communicable and noncommunicable diseases (NCDs). Low- and middle-income countries (LMICs) already account for more than 80% of the global NCD deaths. Countries in the World Health Organization (WHO) Southeast Asia region (SEAR) account for more than one fifth of the global NCD burden. The highest increase (21%) of deaths from NCDs in the next 10 years is predicted to occur (Narain et al. 2011).

Infections have an aetiological role in the development of many NCDs, as demonstrated in studies conducted in various African countries. They thus contribute to substantial chronic disability, lifelong impairments, and economic loss at personal and national levels. In addition to the classical risk factors, it has been suggested to prioritize infections as one of the major risk factors for NCDs in Africa (Mensah and Mayosi 2013). There is scarce documentation of a similar association between infections and NCDs in Asia, even though several Asian countries, such as the people's Republic of China, India, and Indonesia, have a high burden of both NTDs and NCDs (Institute of Health Metrics and Evaluation 2016). NTDs and NCDs share similar characteristics due to their chronic and debilitating nature. They also share several social determinants that influence the exposure, health-seeking behaviours, and health outcomes. The high prevalence of risk behaviours combined with poor health-seeking behaviour may lead to poor health outcomes for both NTDs and NCDs. Furthermore, overlapping determinants, similar target populations, and similar health system challenges for both the NCD and NTD control provide opportunities for cross-learning and streamlining of health interventions at the grassroots level. The available evidence regarding effectiveness of community-based and primary care interventions for NCDs and challenges can be used for planning NTD interventions and vice versa.

### *1.1 Disease Burden of NTDs and NCDs*

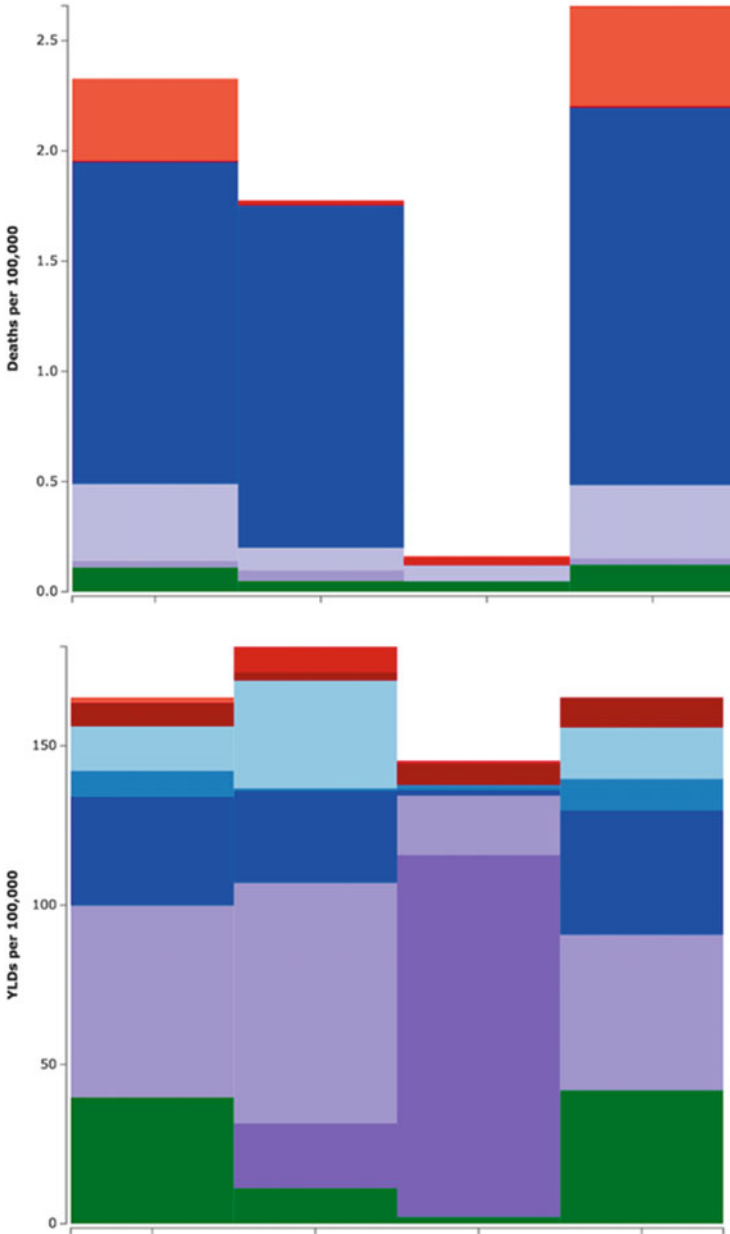
Asia has a high disease burden of both NTDs and NCDs according to the recent global burden estimates (GBD 2016 DALYs and HALE Collaborators 2017). Globally, around a billion people, mostly poor, are affected by NTDs and as a consequence suffer from disability and poor quality of life (World Health Organization 2013). According to the estimates of the Global Burden of Disease study 2010, the 17 NTDs together accounted for about 26.05 million disability-adjusted life years (DALYs), 1% of the global burden of disease and injuries, and an estimated 152,000 deaths. The

most prevalent NTDs, worldwide, include leishmaniasis, schistosomiasis, soil-transmitted helminthiasis, and lymphatic filariasis. Asia contributes the largest number of DALYs from NTDs. The largest number of DALYs for leishmaniasis, hookworm disease, lymphatic filariasis, food-borne trematodiasis, rabies, ascariasis, and dengue occur in South, East, and Southeast Asian countries. In Asia, the leading NTDs are leishmaniasis in India; food-borne trematodiasis in the People's Republic of China, North Korea, the Mekong region, and Japan; and intestinal nematode infections in Southeast Asian countries as a whole (Hotez et al. 2014). NCDs were the leading cause of death with 56 million deaths globally in 2010. LMICs account for nearly 75% of these deaths. NCD deaths increased from 6.7 million to 8.5 million in the WHO Southeast Asia region from 2000 to 2012. Nearly half (48%) of the NCD mortality in LMIC was among people below 70 years as compared to 28% in high-income countries (World Health Organization 2014).

In Asia, the mortality due to NTDs is highest in the South Asian countries, particularly in India. Among the various NTDs, the mortality rate is highest for dengue in South and Southeast Asia (Institute of Health Metrics and Evaluation 2016). Years lived with disability (YLD) for NTDs range from 168 in India to 140 per 100,000 population in the People's Republic of China. India accounts for the most YLD per 100,000 for dengue. The Southeast Asian countries and the People's Republic of China contribute the most YLD due to intestinal nematodes and trematodes, respectively. India also contributes the most DALYs per 100,000 population attributable to NTDs, followed by the Southeast Asian countries as a group. The countries in Southeast Asia contribute the most DALYs per 100,000 population due to dengue and intestinal nematodes, while the People's Republic of China leads in food-borne trematodiasis (Table 1; Fig. 1).

**Table 1** Burden of neglected tropical diseases in Asia according to the Global Burden of Diseases Study 2016

NTD	Southeast Asia	People's Republic of China	India	South Asia
<i>Deaths (per 100,000)</i>	1.7	0.15	2.6	2.3
Dengue	1.5		1.7	1.5
Rabies	0.1	0.07	0.3	0.3
Leishmaniasis			0.5	0.4
<i>YLD (per 100,000)</i>	184	140	168	168
Intestinal nematodes	75.4	18.5	48.9	60.2
Dengue	28.9	1.9	39.1	34.1
Lymphatic filariasis	33.8		16.1	13.8
Food-borne trematodiasis	20.4	113.6		
<i>DALY (per 100,000)</i>	300	150	300	275
Dengue	130.9	1.9	118.3	103.1
Intestinal nematodes	78.8	18.6	50.8	62.3
Leishmaniasis			27.4	24.1
Lymphatic filariasis	33.8		16.1	13.8
Food-borne trematodiasis	20.4	113.6		
Rabies	4.8	2.9	16.2	17.1



**Fig. 1** Burden of neglected tropical diseases in Asia according to the Global Burden of Disease Study 2016

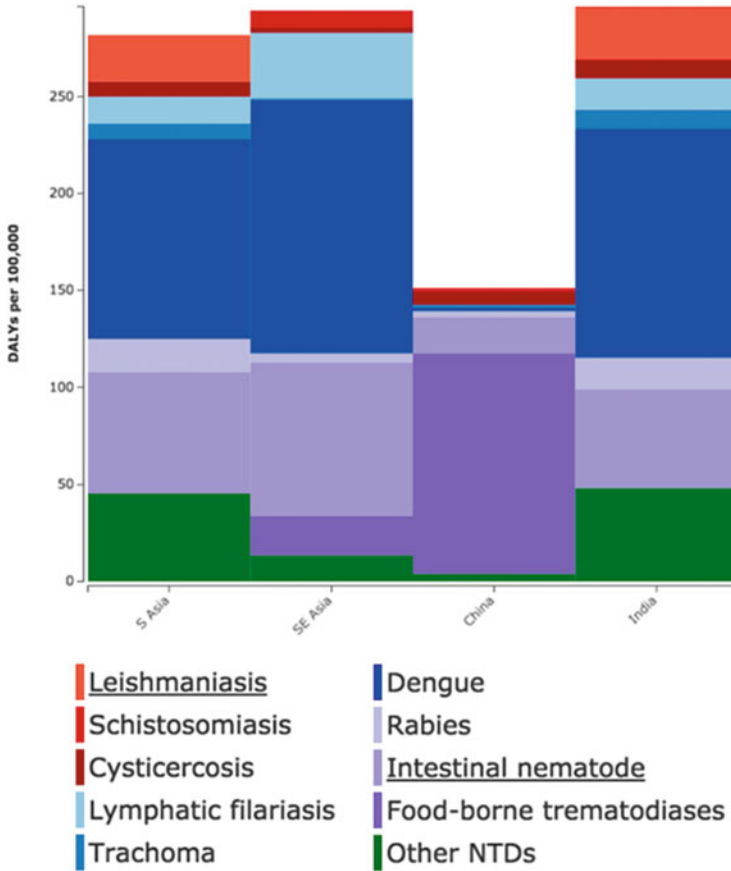


Fig. 1 (continued)

South Asia and Southeast Asia have a high burden of NCDs that account for 62% and 75% of the deaths in these regions, respectively. NCDs account for 60% and more than 80% of the deaths in two major countries in the region, India and the People’s Republic of China, respectively. Among the NCDs, cardiovascular diseases (29–32%), cancers (9–14%), and chronic respiratory diseases (6–10%) were the leading causes of death in South Asia (including India) and Southeast Asia. In 2016, NCDs accounted for 75–82% of the collective YLD in Asian countries. Mental disorders and substance use (16–20%) and musculoskeletal disorders (14–19%) were the major contributors to YLD in these countries. NCDs accounted for 58%, 68%, and more than 80% of the DALYs in South Asia (including India), Southeast Asia, and the People’s Republic of China, respectively, in 2016 (Institute of Health Metrics and Evaluation 2016) (Table 2; Fig. 2).

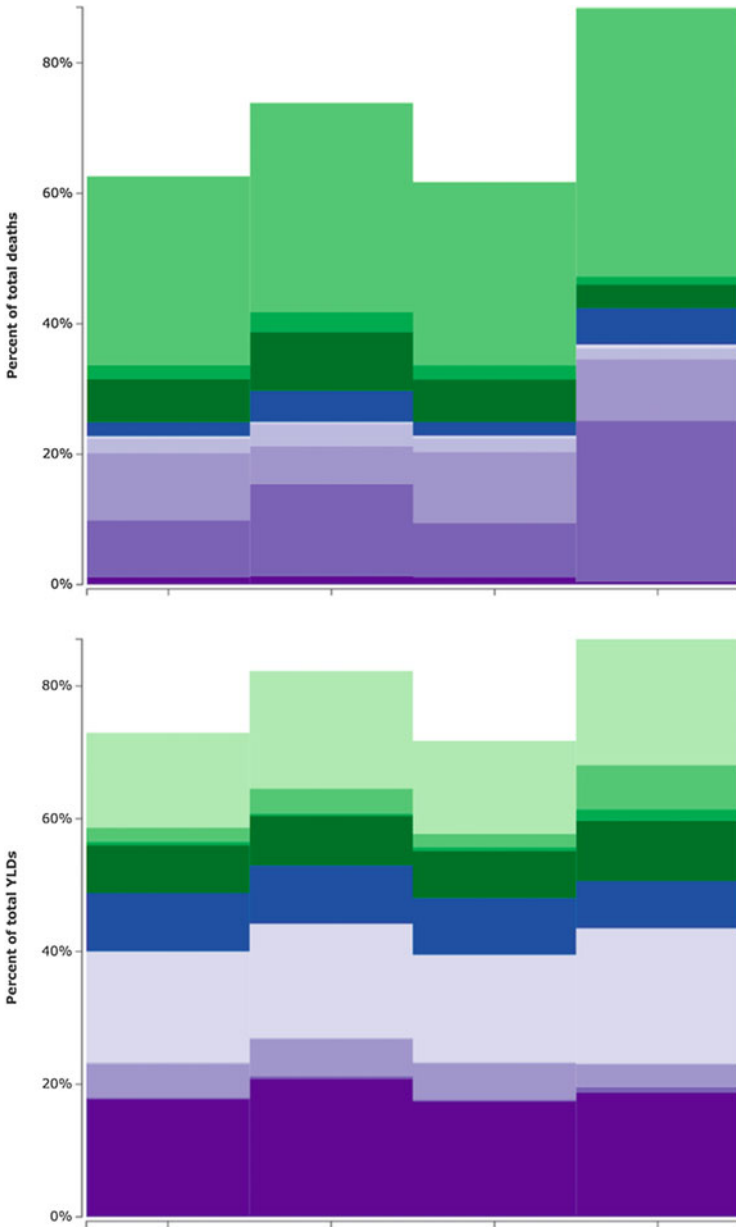
**Table 2** Burden of noncommunicable diseases in Asia according to the Global Burden of Disease Study 2016

NCD	Southeast Asia	People's Republic of China	India	South Asia
<i>Deaths (%)</i>				
CVD	32	41	28	28.9
Neoplasm	14	24	8.3	8.7
CRD	5.8	9.5	10.9	10.3
Diabetes and endocrine	9	3.6	6.5	6.6
<i>YLD (%)</i>				
Mental and substance use	17.2	20.3	16.1	16.7
Neurological disorders	8.8	7.1	8.5	8.8
Musculoskeletal	17.7	18.9	14	14.3
Diabetes and endocrine	7.4	9.1	7.1	7.2
<i>DALY (%)</i>				
CVD	16.6	22.5	14	14.1
Neoplasm	8.5	16.9	5	5.2
Diabetes and endocrine	7.5	5.8	5.6	5.6
Mental and substance use	6.2	8.6	5.6	5.7
CRD	4.5	5.1	6.4	5.8

## 2 Economic Burden of NTDs and NCDs

A dual burden of NTDs and NCDs can inflict a high economic burden on the affected population due to high treatment costs and consequently low affordability. Most health expenditure in poor countries is out of pocket, and the cost of treatment for these diseases therefore puts a direct burden on low-income families. The huge macroeconomic impact of these diseases is due to a combination of costs to individuals, families, governments, and health systems.

Direct and indirect costs incurred for the treatment of NTDs can lead to “catastrophic health expenditures” (Damme et al. 2004). Inability to pay has been associated with all NTDs (Aagaard-Hansen and Chaignat 2010). There is documented evidence for the high cost of dengue fever in Thailand and high out-of-pocket expenditure (OOPE) leading to debt during dengue epidemics in Cambodia (Damme et al. 2004; Anderson et al. 2007). Poverty has been described as “a potentiator of leishmaniasis morbidity and mortality” (Alvar et al. 2006). Treatment for leishmaniasis in the private sector health facilities had led to the sale of assets and heavy borrowing in Nepal (Uranw et al. 2013). A study from Bangladesh demonstrated the negative financial impact of visceral leishmaniasis (Anoop Sharma et al. 2006). Loss of productivity due to acute and chronic lymphatic filariasis has been demonstrated by studies from India’s Odisha state and South India (Ramaiah et al. 2000; Babu and Babu 2014). The economic impact of the NTDs also results from its adverse effects on school attendance and child development, agriculture (especially from zoonotic NTDs), and overall economic productivity, including loss of tourism (Miguel and Kremer 2004; Mavalankar et al. 2009).



**Fig. 2** Burden of noncommunicable diseases in Asia according to the Global Burden of Disease Study 2016

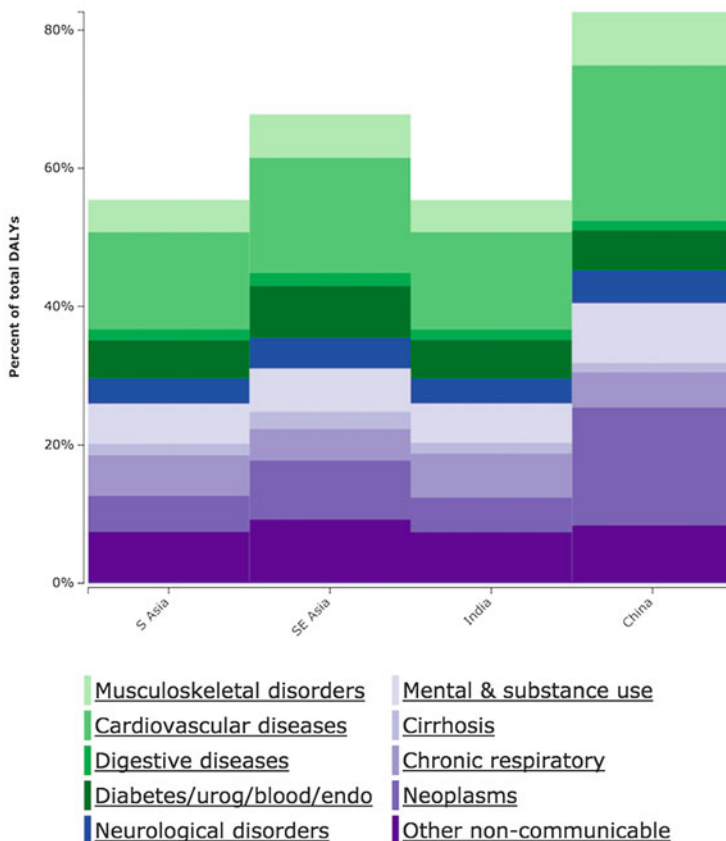


Fig. 2 (continued)

The economic burden of NCDs occurs at both macroeconomic and household levels. It is estimated that there is 0.5% reduced annual economic growth for every 10% rise in NCDs (World Health Organization 2011). The gross domestic product (GDP) loss at the country level will be very high if nothing is done to reduce the risk of NCDs in the region. The GDP loss was estimated to be US\$16.68 billion, US \$4.18 billion, US\$1.49 billion, and US\$1.14 billion in India, Indonesia, Thailand, and Bangladesh, respectively, during the 2006–2015 period (Abegunde et al. 2007a). The rising burden of NCDs in the SEAR has led to the loss of household income due to the loss of productivity and high OOPE for the treatment. The share of chronic diseases among the household OOPE increased from 31.6% to 47.3% from 1995–1996 to 2004 in India. Medicines, diagnostic tests, and medical appliances contributed to nearly half of the OOPE on chronic diseases in India (Engelgau et al. 2011). OOPE for hospital treatment accounted for a large proportion of household expenditures, i.e. 30% for CVD and 17% for diabetes as per a national survey in India in 2004 (Rao et al. 2011). The People’s Republic of China also has huge healthcare expenditure for NCD with 31.9 billion and 10.7 billion Chinese yuan



spent on hypertension and diabetes treatment, respectively, which accounted for 5.6% and 1.9%, respectively, of the total national health expenditure (Xiao et al. 2014).

### 3 NTDs as Risk Factor for NCDs

Most NTDs have a chronic course of disease resulting in long-term disability. Similar to NCDs that require lifelong treatment, many NTDs may persist for decades or longer. There is limited but growing evidence for the contribution of NTDs to the NCD burden, especially in the context of the poor populations in LMICs.

Many of the NTDs prevalent in Africa were associated with an increased risk of NCDs. This association is also documented for specific NTDs prevalent in Asia. Among the cancers, opisthorchiasis and clonorchiasis have been shown to cause bile duct carcinoma in Southeast Asia and The People's Republic of China. Schistosomiasis has been linked to intestinal and liver fibrosis in East Asia and amebiasis to liver cysts in India. Hookworm infection and schistosomiasis significantly contribute to anaemia, particularly in children and pregnant women in LMICs. Paragonimiasis and ascariasis lead to chronic respiratory conditions such as hemoptysis in East Asia and asthma, respectively (Hotez and Daar 2008). Congestive heart failure is one of the complications of hookworm infection. Myocardial dysfunction was found in 6.7% of all cases with dengue fever, 13.8% with dengue haemorrhagic fever, and 36% with dengue shock syndrome (Moolani et al. 2012).

#### 3.1 *Social Determinants and Consequences of NCDs and NTDs*

##### 3.1.1 **Poverty and Socio-economic Status**

The high burden of NTDs and NCDs among the poor can be partly attributed to their high exposure to risk factors and behaviours. Poverty has been documented as determinant for all major NTDs and is closely linked to intermediate determinants such as education, occupation, water, sanitation, and housing (Aagaard-Hansen and Chaignat 2010; Conteh et al. 2010). NCDs such as cardiovascular diseases were initially considered diseases of the affluent class; however, lower socio-economic groups are also affected by these diseases, particularly if they adopt some modern lifestyles and foods (Jeemon and Reddy 2010).

Tobacco use, a major risk factor for NCD, is highly prevalent in the Southeast Asia region with very high per head annual cigarette consumption in Indonesia (974 cigarettes) and the Philippines (1073 cigarettes). Prevalence of tobacco consumption was two times higher among least wealthy population, as compared to the highly affluent in Myanmar, Malaysia, the Philippines, Lao People's Democratic

Republic, and Vietnam (Dans et al. 2011). Similarly, smoking prevalence was higher among males with no formal schooling (39 vs. 14%) as compared to those with secondary or above education in a national survey in India (Indian Institute of Population Sciences and Ministry of Health and Family Welfare 2010). There was also an increase in smoking, diabetes, and dyslipidemias in the lower socio-economic groups in serial epidemiological surveys in an urban population in western India (Gupta et al. 2003). A multicentric study of 19,969 individuals in the urban industrial populations across India showed an inverse gradient between education and risk factors such as tobacco usage and hypertension. In addition, there was also an inverse gradient for diabetes and overweight in the industrial populations in highly urbanized settings (Reddy et al. 2007).

Poverty is also one of the consequences of NTDs and NCDs that may further lead to higher vulnerability and poor health outcomes. It can be an outcome of NTDs due to the high cost of treatment or loss of wages associated with diseases such as leishmaniasis and lymphatic filariasis (Aagaard-Hansen and Chaignat 2010). Several NTDs are characterized by a cycle of poverty and disease (Hotez et al. 2009). Similarly, high costs of treatment for NCDs can push people into poverty. The odds of catastrophic spending and impoverishment were higher for those hospitalized with chronic diseases than for those hospitalized with communicable diseases, the highest being for CVD and cancers in India (Mahal et al. 2010).

### 3.1.2 Urbanization and Migration

Migration is linked to socioeconomic factors and leads to change in behaviours, vulnerability, access to health services, and healthcare outcomes for NTD and NCDs. NCD risk factors were highly prevalent in the suburban slums in metropolitan cities such as Delhi and Kolkata in India that have predominantly migrant populations (Anand et al. 2007; Acharyya et al. 2014). The industrial workers who migrated from rural areas to urban areas in India had higher rates of obesity and diabetes as compared to their siblings who continued to stay in rural areas (Ebrahim et al. 2010). Studies among migrating communities have documented the inadequacy of health services and control programmes for Guinea-worm disease in India and Pakistan and parasitic diseases in Thailand (Watts 1987; Petney 2001). Increasingly mobile populations and livestock migrations into mountainous regions have been shown to be a challenge for schistosomiasis control in the People's Republic of China (Xianyi 2002).

### ***3.2 Psychosocial Determinants and Consequences of NCDs and NTDs***

Patients with NCDs and NTDs have an increased psychosocial burden due to the need for prolonged treatment, which naturally results in additional costs of care. In addition, stigma adds to the psychosocial burden specifically for NTDs and influences health-seeking behaviour and treatment adherence (Reithinger et al. 2005). Depression is one of the comorbidities observed in NCDs and NTDs. Depression is highly prevalent among patients with myocardial infarction, cancers, chronic respiratory disease, and neurological disorders in Southeast Asian countries (Hengrasmee et al. 2004; Lueboonthavatchai 2007; Nidhinandana et al. 2007; Agarwal et al. 2011; De 2011). Social stigma is also associated with many of the NTDs, at the individual, family, and community level. Stigma and psychiatric morbidity has been associated with NTDs prevalent in Asia, including lymphatic filariasis, trachoma, and leprosy (Perera et al. 2007; Weiss 2008). Stigma is one of the contributors to poor mental health in addition to limited access to health services, the negative economic impact, and the violation of socio-political rights among patients with NTDs (Litt et al. 2012; Molyneux 2012). Various psychological consequences of stigma derived from NTDs, including depression, have been linked to lymphatic filariasis, onchocerciasis, and leishmaniasis (Hofstraat and van Brakel 2016). Stigma not only influences disease outcomes but also has a negative economic impact. Disfigurement caused by lymphatic filariasis stigmatizes communities where cases cluster and has been shown to impair earning capacities in India (Bandyopadhyay 1996).

In addition to stigma, gender issues might further contribute to differentials in morbidity, mortality, societal function, and health-seeking behaviour for many of the NTDs, depending on the country-specific cultural context (Vlassoff and Manderson 1998). Women were documented to underreport leishmaniasis, which delayed their access to diagnosis and treatment (Ahluwalia et al. 2003). One explanation for this behaviour might be that women are disproportionately stigmatized by the scarring sequelae of cutaneous leishmaniasis that can impair social life in Pakistan and Afghanistan (Reithinger et al. 2005; Kassi et al. 2008). Female leprosy patients in India reported delayed initiation of treatment, coupled with more adverse community response and more disruption of their routine activities (Rao et al. 1996; Zodpey et al. 2000).

### ***3.3 Interventions for NTD and NCD Control: Learning from Experiences in the Region***

#### **3.3.1 Prioritizing NTD and NCD Control in Global and Regional Health Agendas**

There have been efforts at the global and regional level to put NTDs and NCDs on the priority agenda. The World Health Assembly (WHA) passed resolutions calling for the global elimination of leprosy and lymphatic filariasis in 1991 and 1997, respectively (World Health Assembly 1991, 1997). There have been many efforts to address NCD control in the past decade. The WHO FCTC was adopted by the WHA in 2003 and ratified by many countries in the Asia region. The Global Strategy on Diet, Physical Activity and Health was endorsed by the WHA in 2004. Another major milestone was the development of the 2008–2013 Action Plan for the Global Strategy for the Prevention and Control of NCDs. The high-level meeting of the general assembly in September 2011 with participation of heads of states brought NCDs on the priority agenda of most countries in the Asian region (World Health Organization 2011).

The countries of the Southeast Asia region are making progress towards eliminating leprosy, lymphatic filariasis, visceral leishmaniasis, and yaws as public health problems (i.e. reducing annual incidence to less than 1 per 10,000 population at the district or subdistrict level, depending on the country). India, Bangladesh, and Nepal have scaled up treatment and control strategies towards elimination of visceral leishmaniasis. Indeed, a memorandum of understanding was signed by India, Nepal, and Bangladesh for joint efforts to eliminate visceral leishmaniasis by the year 2015, and a resolution was passed by the WHO Southeast Asia Regional Committee in 2006, to intensify efforts towards achieving the goals of eliminating selected NTDs (World Health Organization Regional Office for South-East Asia 2006). A Regional Programme Review Group in the Southeast Asia region monitors the goal of eliminating lymphatic filariasis by 2020. The main strategy for the elimination of lymphatic filariasis is mass administration of diethylcarbamazine (DEC) and albendazole. Areas endemic for lymphatic filariasis have been fully mapped in all endemic countries of the region except Indonesia. High coverage of mass drug administration (MDA) for treatment of lymphatic filariasis has been shown in Bangladesh and India, while Maldives, Sri Lanka, and Thailand have already achieved elimination. India declared elimination of yaws in 2006 (Narain et al. 2010). In Indonesia, a yaws elimination programme was initiated in four hyperendemic provinces, while in Timor-Leste, yaws control is part of an integrated campaign that includes other skin diseases, such as leprosy (Narain et al. 2010). All countries of the region except Timor-Leste have attained leprosy elimination.

Several international initiatives further support national NTD control and elimination programmes in terms of advocacy, technical assistance, and/or financing. These include the Global Alliance for the Elimination of Lymphatic Filariasis (GAELF) and the International Trachoma Initiative in Nepal and Vietnam as external partners of WHO and the International Federation of Anti-Leprosy Associations

(ILEP), an umbrella organization of non-governmental organizations (NGOs) (Liese et al. 2010).

In contrast, there is limited progress made in NCD control. For example, there is varying level of implementation of tobacco control interventions such as taxation measures, legislation to prevent exposure to tobacco smoke, enhancing public awareness, bans on tobacco advertising, promotion and sponsorship, and reducing tobacco dependence (Narain et al. 2011).

### ***3.4 Strategies, Policies, and Programmes for NCD and NTD Control***

The interventions to address NCDs and NTDs share certain common strategies that can be implemented synergistically considering limited resources available to address these diseases. The WHO promotes the use of five public health strategies to control, eliminate, and eradicate NTDs. These include (1) preventive chemotherapy; (2) innovative and intensified disease management; (3) vector control and pesticide management; (4) provision of safe drinking water, basic sanitation and hygiene, and education; and (5) veterinary public health services (World Health Organization 2013). The strategies recommended for NCD control include reducing risk factors through primary prevention and health promotion, early detection and management of NCDs, surveillance, and delivering interventions through primary care (Narain et al. 2011). Strategies for NTD and NCD control thus have common focus on determinants for primary prevention and a primary care approach to early detection and treatment.

The countries in Southeast Asia and East Asia require a national policy and organizational structures to support interventions for NCDs and NTDs. There has been encouraging progress in the response from governments for NCD and NTD control. There has also been a change in the organizational structure of NTD and NCD programmes with a growing trend towards horizontal integration of multiple NTDs or multiple NCDs under one programme.

There has been major progress in the governance of NCD programmes over the past decade. A review of governance structures in 18 LMICs in East Asia and the Pacific reported separate governance structures for different chronic diseases in 2010. Many countries initially started multiple vertical programmes, but in recent years, there was a trend towards merging the programmes, e.g. the Philippines merged three vertical programmes in 2000, and similar trends were observed in Mongolia and Malaysia. National health plans of the majority of the LMICs mentioned chronic diseases in the sector-wide plans (Rani et al. 2012).

India had several programmes addressing various NCDs and NTDs. The National Rural Health Mission was launched in 2004 by the government of India. It provided a platform for integrating various vertical disease control programmes. Historically, the government of India had several vertical programmes for NCDs. The National

Health Programmes for cancer, blindness, and mental health were started in 1975, 1976, and 1982, respectively. A national programme for prevention and control of cancer, diabetes, CVD, and stroke was launched in 2010–2011. Cancer is integrated in this programme under the broad structure of National Health Mission (Srivastava and Bachani 2011). The National Vector Borne Disease Control Programme (NVBDCP) includes the control of all major NTDs in the country, including visceral leishmaniasis, lymphatic filariasis, and chikungunya. The visceral leishmaniasis control programme, originally a vertical programme, was merged with the NVBDCP under the “National Rural Health Mission” in the year 2005 with the strategy of oral administration of miltefosine and indoor residual spraying (Muniaraj 2014). In addition to various programme-based initiatives, the government of India has also worked to catalyze research and development (R&D) for NTDs. One such initiative in the Indian biotech sector is the launching of a public-private partnership, Biotechnology Industry Research Assistance Council (BIRAC). Furthermore, the Open Source Drug Discovery (OSDD) platform of the Council of Scientific and Industrial Research (CSIR) of India is part of a global network of OSDD groups and includes R&D projects for NTDs (Global Health Progress 2013).

Bangladesh started its visceral leishmaniasis elimination programme in 2007 and is now considered to be on track for elimination by the end of 2017. In 2011, a visceral leishmaniasis research centre was established in Northern Bangladesh in collaboration with the Directorate General of Health Services (Ministry of Health and Family Welfare, Bangladesh), Drugs for Neglected Diseases initiative (DNDi), Japan International Cooperation Agency (JICA), and Japan Science and Technology Agency (JST), Institute of One World Health (now merged with PATH), and the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) (Nawaz 2014).

The Second Long-Term Health Plan (1997–2017) of Nepal has also included visceral leishmaniasis in the “Essential Health Care Services” (EHCS) with provision of free treatment and indoor residual spraying. However, concerns have been raised over the ineffective implementation of the control strategies, including poor surveillance, inaccessibility to treatment, low quality of spraying, ineffective public awareness measures, and availability of treatment only in public sector hospitals (Adhikari 2013).

As part of its NTD National Action Plan (2011–2015), the Indonesian Ministry of Health conducts MDA for soil-transmitted helminth infections in collaboration with the Directorates of Maternal-Child Health (MCH) and Nutrition, local NGOs (“Kusuma Buana”), and with technical and financial assistance from RTI International and the US Agency for International Development (USAID) (World Health Organization and Husada 2011). In addition, the IMOH’s Centre for Health Promotion has implemented a programme for hygiene education and outreach. The control programmes for NTDs in Indonesia are implemented by the Ministry of Health with additional financial support from UNAIDS, the Australian Department of Foreign Affairs and Trade, and UNICEF (Tan et al. 2014). Working towards the goal of global elimination of lymphatic filariasis by 2020, different parts of the country are in various stages of the lymphatic filariasis elimination programme, including

mapping of endemic areas, MDA implementation, and post-transmission assessment surveillance (TAS) (Krentel et al. 2016). Currently, albendazole is provided free of cost by GlaxoSmithKline through WHO, while DEC is procured with the national budget (World Health Organization and Husada 2011).

### ***3.5 Service Delivery Using Primary Care Approach***

The health systems in most East Asian countries are oriented to maternal and child health and communicable diseases. Most of the NTDs and all NCDs require long-term care, prolonged drug treatment, and disability prevention and management. Health systems need to be restructured for efficient use of limited resources. Current health services require the visit of multiple facilities by patients that are not appropriate for efficient and effective chronic disease management (Allotey et al. 2011). Available models and ongoing programmes that focus on primary care in either NCDs or NTDs provide an opportunity to identify the elements that can be scaled up in low-resource settings.

Several countries in Asia are developing strategies for integrating NCD interventions in primary healthcare systems. NTD interventions can be integrated and implemented along with ongoing primary healthcare activities, including immunization campaigns, antenatal care, maternal and child health services, and school health programmes (Bhutta et al. 2014). Malaysia has developed NCD screening and management interventions in the primary healthcare system with key roles played by nurses and medical assistants. These healthcare providers were trained to provide services related to chronic conditions, such as self-management and clinical care for chronic diseases (Mustapha et al. 2014). The People's Republic of China has also developed a primary healthcare-based NCD program that involves establishing personal health record of each individual, identification of individuals with risk factors and treatment, and follow-up of patients with hypertension and diabetes (Xiao et al. 2014).

Patients with NTDs and NCDs require counseling in addition to medical management for modifying risk behaviours, self-management, and associated psychosocial comorbidities. A clinical trial on smoking cessation intervention among diabetics in a primary care setting in Kerala, India, demonstrated higher odds for quitting smoking [8.4, 95% confidence interval (CI): 4.1–17.1] in the intervention group at 6 months (Thankappan et al. 2013). Psychosocial issues related to stigma from NTDs and comorbidities such as depression that occur in both NCD and NTD patients can also be addressed in primary care. A combination of drugs and psychosocial interventions involving lay health workers trained as counselors and primary care physicians was effective in primary healthcare settings in Goa, India. Six-month recovery from depression was higher in the intervention as compared to the control arm (65 vs. 53%, risk ratio (RR) 1.22, 95% CI 1.00–1.47) (Patel et al. 2010).

### 3.6 *Human Resources for Service Delivery*

One of the challenges in managing NTDs and NCDs is the lack of adequate human resources. Programmes require active involvement of community healthcare workers and other non-physician health workers to sustain the programme activities. Health workers need to be properly incentivized to ensure their retention and programme sustainability (Bhutta et al. 2014). There has been a trend towards developing capacity at all levels and involving all cadres of health workers to implement programmes in low-resource settings. WHO supports capacity building of endemic countries by strengthening the training and implementation capacity for NTD control (World Health Organization 2013). WHO has also developed a CVD risk management package for use by health workers in low-resource settings (Abegunde et al. 2007b).

Nurses are one category of paramedical workers that can be trained to deliver interventions in primary care settings. They can play a key role in providing services in low-resource settings. Tamil Nadu, India, has a nurse-based model for screening and management of NCDs in primary health centres (PHC) and secondary care hospitals. The programme has placed a nurse in every PHC that conducts screening for cervix (VIA/VILI) and breast (clinical breast examination) cancers, hypertension, and diabetes as per protocol. The nurse does counseling, monitors the blood pressure and other parameters for patients on follow-up for hypertension/diabetes, maintains records, and prepares monthly reports. This model is feasible and has led to the implementation of NCD interventions in a systematic manner (Tamil Nadu Health Systems Project 2012).

Community volunteers and lay health workers can also play key roles in delivering various interventions at the community level for NTDs and NCDs. MDA programmes for filariasis involve various human resources such as community volunteers, auxiliary nurse midwives, Accredited Social Health Activists (ASHAs), school teachers, and local administrative bodies to achieve their goals (Srivastava et al. 2014). Non-physician health workers played a key role in identifying high-risk groups in various NCD interventions. A study from India and Pakistan demonstrated 80% agreement between doctor and non-physician health worker in implementing the CVD risk management package developed by WHO for cardiovascular risk assessment in low-resource settings (Abegunde et al. 2007b). Lay health workers from the community have been successfully employed to conduct screening, follow-up, and behavioural interventions for diabetes and mental disorders. A systematic review to improve diabetes care among the socially disadvantaged populations identified lay people as best suited to leading the intervention due to their frequent contact with the patient. Tailoring the interventions within the context of local communities and focusing on behaviour-related tasks have been proven to improve diabetes management (Glazier et al. 2006). Community-based mental health programmes that involve community volunteers in Tamil Nadu, India, were well accepted by the community and feasible with limited resources (Padmavati 2005).



## 4 Drugs for the Management of NTDs and NCDs

Availability and access to drugs is a challenge for both NCDs and NTDs. There have been efforts to enhancing the availability of drugs for NTD, but a substantial gap of US\$300 million per year for the procurement and delivery of quality essential drugs remains (Molyneux 2014). The access to essential medicines for the management of NCDs is also not adequately addressed in most South and Southeast Asian countries (Mendis et al. 2007b).

NTD control measures can be integrated by combining vertical MDA efforts and creating a “rapid impact” package of donated or low-cost generic drugs that is implemented using WHO guidelines. In Asia, such drugs include albendazole or mebendazole, DEC, praziquantel, ivermectin, and azithromycin (Hotez et al. 2009). A combination of albendazole, praziquantel, and ivermectin was reported to be well tolerated, with negligible adverse events among healthy volunteers in Thailand (Na-Bangchang et al. 2006). NTD programmes in endemic countries are often beneficiaries of public-private partnerships in terms of the drug donations by 10 pharmaceutical companies that reach an estimated annual value of US\$2 billion (Bush and Hopkins 2011). In Asian countries, free supply of multidrug therapy for leprosy is provided by Novartis since 2000, while albendazole, required for MDA to eliminate lymphatic filariasis, is provided by GlaxoSmithKline (1998–2020) through WHO. Pfizer and Johnson & Johnson have an open-ended programme for supply of azithromycin for trachoma and mebendazole for soil-transmitted helminthiasis, respectively (Liese et al. 2010).

Drug availability for NCDs is poor in the public sector in most countries. A study of 32 essential medicines in 6 LMICs including Bangladesh, Nepal, and Sri Lanka from Southeast Asia found that only 7.5% of 32 medicines were available in the public sector except in Sri Lanka, where 28% were available. There was a large variation in the cost of 1 month worth of combination treatment for coronary heart disease. The cost ranged from 6.1 daily wages in Nepal to 1.6 daily wages in Bangladesh (Mendis et al. 2007a). High costs and a lack of availability of essential medicines for chronic respiratory disease were reported in a study from five Indian states. Beclomethasone and salbutamol inhalers for chronic respiratory diseases were available in only 25% and 30% of public facilities in Rajasthan state. The cost of one inhaler ranged from 1.5 to 2.5 days wages for the lowest-paid government worker (Kotwani 2009). Poor access to low-cost drugs such as aspirin, beta-blockers, and statins was reported in a multicountry survey of 10,000 cardiovascular disease patients in 10 countries including India, Indonesia, and Sri Lanka. Lessons learnt from NTD programmes in improving the access to drugs can be used to design strategies and programmes for NCDs (Yusuf et al. 2011).

#### ***4.1 Community Involvement and Community-Based Interventions***

Community mobilization is one of the interventions common to NTD and NCD. Community involvement can be useful to address risk behaviours, conduct screening and long-term follow-up for NCD and NTD, and increase acceptance of MDA. Community-based interventions for dengue, trachoma, leishmaniasis, and leprosy have been shown to be effective in several Asian countries, especially in combination with vertical vector control programmes which resulted in wide community coverage and acceptance (Bhutta et al. 2014; Das et al. 2014).

Community-based strategies and structures can provide platforms for delivering various NCD and NTD interventions. Malaysia developed a community-based NCD intervention programme that utilized strategies developed for communicable disease programmes. One of the strategies was the involvement of healthcare volunteers who were not paid for the services but were given other incentives, such as certificates from ministry and travel support to participate in the national meetings. An annual conference was organized for volunteers which provided a platform for presenting the projects and experience sharing. Health clinic advisory panels were also constituted to act as a bridge between the community and programmes. The main role of the panels was health promotion, and they also participated in developing locally appropriate training modules (Mustapha et al. 2014).

There is evidence of the effectiveness of community-based approaches for NCD and NTD control. Community-based interventions were effective in reducing the burden and intensity of soil-transmitted helminthiasis, schistosomiasis, and anaemia globally, including in Asia (Salam et al. 2014). Knowledge and education of the community, strong commitment of all stakeholders, and ensuring participation and enthusiasm of healthcare workers in the routine health services have been demonstrated to be key for the effectiveness of interventions against helminth infections in Vietnam (Phuc et al. 2009). Community-based interventions targeting NCD risk factors in large intervention programmes in Vietnam reported a reduction in blood pressure in the intervention group (Nguyen et al. 2012). Community mobilization has also been demonstrated to be an effective tool for reducing alcohol use. Community leaders can be sensitized, and locally relevant solutions can be developed involving community stakeholders (Schmidt et al. 2010).

One of the major community-based interventions against NTDs in Asian countries is community-directed MDA. The People's Republic of China was the first country to eliminate lymphatic filariasis through MDA and other tools. India's National Health Policy envisaged elimination of lymphatic filariasis in India by 2015. Subsequent to a pilot project initiated in 1996–1997 with yearly single-dose MDA of DEC in 13 identified districts of 7 states and covering about 41 million people, MDA was extended to 31 districts including 11 districts with co-administration of DEC and albendazole in 2002. It was scaled up in a phased manner, and currently, all the districts are being covered with the two drugs. The MDA is driven by the health services and implemented by health workers or

community volunteers, who were selected by healthcare personnel and carry out house-to-house distribution of drugs. The population coverage during MDA has improved from 73% in 2004 to 83% in 2013, resulting in a reduction of the overall microfilaria rate from 1.2% (2004) to 0.3% (2013). In all, 203 out of 255 districts reported a microfilaria rate of less than 1%. This progress has been achieved through a coordinated implementation strategy from the central to peripheral levels, including setting up of a State Task Force and State Technical Advisory Committees; training of district level officers and nodal officers involving faculty of medical colleges, research institutions, and district coordination committees; preparation of micro action plans for rural and urban areas, plans for lymphedema management and hydrocele operations; and supply and distribution of operational guidelines and drugs (Srivastava et al. 2014). Worryingly, a recent review of India's programme for the elimination of lymphatic filariasis highlighted the gaps in the MDA infrastructure and implementation, including irregularity in monthly MDA, poor compliance to drugs, especially in urban areas, discrepancy between reported coverage and survey findings, failure by drug distributors to visit a household, absence of people from their house during MDA, lack of awareness among the at-risk population of the benefits of the MDA, misconceptions about its risks, inaccurate information about drug adverse reactions, and poor knowledge and perceptions of lymphatic filariasis in endemic communities (Babu and Babu 2014). MDA for lymphatic filariasis was seen to be poorly acceptable to people from different caste systems in Tamil Nadu, India (Ramaiah et al. 2001). There is a need to understand the social structures of endemic communities along with addressing the accessibility, acceptability, and affordability of the public health interventions (Jacobs et al. 2012).

The Indonesian Ministry of Health plans to eliminate schistosomiasis by 2020 through MDA of praziquantel to individuals over the age of 4 years, along with health education, environmental management, and agro-engineering. MDA with DEC and albendazole is the major strategy for combating lymphatic filariasis in Indonesia. However, the current drug coverage in the major endemic districts is only approximately 30% (World Health Organization and Husada 2011). Barriers to access these drugs include social stigmatization linked to lymphatic filariasis (Sudomo et al. 2010), the island geography with remote populations, compliance (Bhullar and Maikere 2010), and government budgetary constraints (Tan et al. 2014).

School-based interventions for NTDs and workplace-based interventions for NCDs have been shown to be feasible and effective in Southeast Asia. School-based delivery of preventive and promotive interventions, in collaboration with the educational authorities and the school personnel, was cost-effective in Thailand (Hathirat et al. 1992). One worksite intervention programme in India demonstrated the effectiveness of health promotion interventions for reducing the prevalence of risk factors for cardiovascular diseases (Prabhakaran et al. 2009).

## 4.2 *Challenges and Opportunities*

Although the control and management of NTDs has made significant progress in recent years, there are continuing and emerging challenges that can be stratified as biological, socio-geographical, strategic, logistic, and technical (Bockarie et al. 2013). Given that NTDs contribute to lost national income via loss in productivity in endemic countries, there is a need to fill the gap in resources and advocacy through political commitment and continued collaborations among all stakeholders (Molyneux 2014; Lenk et al. 2016). A major challenge is the coordination of governance arrangements and multiple partners—international, national governments, and local bodies for NTD programmes at the in-country implementation level. Operationally, this would require integration of the control efforts into the country's overall health system, interdepartmental collaboration, and intra-ministerial coordination (Liese et al. 2010; Molyneux 2014).

There has been progress in NCD control in the past decade with various policies and programmes being implemented. However, NCDs are not yet recognized as a national health priority in many countries in the region. LMICs in the region have the highest proportion of mortality due to NCDs, and data from countries such as India show the rising burden of NCDs among the poor, while there is a general misperception that NCDs affect the wealthy. The NCDs are predominantly linked to harmful behaviours due to individual choices, but the influence of the socio-economic status and environment is not fully acknowledged (World Health Organization 2011). Health systems in several Asian countries have competing priorities due to their high burden of infectious diseases, NTDs, and maternal and child health conditions. Health systems lack adequate resources to tackle the rising burden of NCD care.

The lessons learnt from NCD and NTD control in the countries in the South and Southeast and East Asian region provide evidence for scaling up and combining several interventions in primary care and at the community level. Community resources can be leveraged for both NCD and NTD control. The control efforts need to target the poor and focus on determinants that are influenced by socio-economic conditions. The resources in the health system should be judiciously allocated to strengthen primary care and ensure adequate availability of funds, human resources, and drugs. The interventions should not only focus on drugs but comprehensive care that also addresses psychosocial issues and behavioural change. Further research is required to understand the NCD comorbidities among patients with NTDs prevalent in the region.

## References

- Aagaard-Hansen J, Chaignat CL (2010) Neglected tropical diseases: equity and social determinants. World Health Organization, Geneva
- Abegunde DO, Mathers CD, Adam T, Ortegón M, Strong K (2007a) The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet* 370:1929–1938

- Abegunde DO, Shengelia B, Luyten A, Cameron A, Celletti F, Nishtar S, Pandurangi V, Mendis S (2007b) Can non-physician health-care workers assess and manage cardiovascular risk in primary care? *Bull World Health Organ* 85:432–440
- Acharyya T, Kaur P, Murhekar M (2014) Prevalence of behavioral risk factors, overweight and hypertension in the urban slums of North 24 Parganas District, West Bengal, India, 2010. *Indian J Public Health* 58:195–198
- Adhikari S (2013) Kala-Azar policy and programmes in Nepal: an assessment. *J Bioterr Biodef* 4:124
- Agarwal M, Trivedi JK, Sinh PK, Dalal PK, Saran RK (2011) Depression in patients of myocardial infarction—a cross-sectional study in northern India. *J Assoc Physicians India* 59:636–638, 643
- Ahluwalia IB, Bern C, Costa C, Akter T, Chowdhury R, Ali M, Alam D, Kenah E, Amann J, Islam M, Wagatsuma Y, Haque R, Breiman RF, Maguire JH (2003) Visceral leishmaniasis: consequences of a neglected disease in a Bangladeshi community. *Am J Trop Med Hyg* 69:624–628
- Allotey P, Reidpath DD, Yasin S, Chan CK, de-Graft Aikins A (2011) Rethinking health-care systems: a focus on chronicity. *Lancet* 377:450–451
- Alvar J, Yactayo S, Bern C (2006) Leishmaniasis and poverty. *Trends Parasitol* 22:552–557
- Anand K, Shah B, Yadav K, Singh R, Mathur P, Paul E, Kapoor SK (2007) Are the urban poor vulnerable to non-communicable diseases? A survey of risk factors for non-communicable diseases in urban slums of Faridabad. *Natl Med J India* 20:115–120
- Anderson KB, Chunsuttiwat S, Nisalak A, Mammen MP, Libraty DH, Rothman AL, Green S, Vaughn DW, Ennis FA, Endy TP (2007) Burden of symptomatic dengue infection in children at primary school in Thailand: a prospective study. *Lancet* 369:1452–1459
- Anoopa Sharma D, Bern C, Varghese B, Chowdhury R, Haque R, Ali M, Amann J, Ahluwalia IB, Wagatsuma Y, Breiman RF, Maguire JH, McFarland DA (2006) The economic impact of visceral leishmaniasis on households in Bangladesh. *Trop Med Int Health* 11:757–764
- Babu BV, Babu GR (2014) Coverage of, and compliance with, mass drug administration under the programme to eliminate lymphatic filariasis in India: a systematic review. *Trans R Soc Trop Med Hyg* 108:538–549
- Bandyopadhyay L (1996) Lymphatic filariasis and the women of India. *Soc Sci Med* 42:1401–1410
- Bhullar N, Maikere J (2010) Challenges in mass drug administration for treating lymphatic filariasis in Papua, Indonesia. *Parasit Vectors* 3:70
- Bhutta ZA, Salam RA, Das JK, Lassi ZS (2014) Tackling the existing burden of infectious diseases in the developing world: existing gaps and the way forward. *Infect Dis Poverty* 3:28
- Bockarie MJ, Kelly-Hope LA, Rebollo M, Molyneux DH (2013) Preventive chemotherapy as a strategy for elimination of neglected tropical parasitic diseases: endgame challenges. *Philos Trans R Soc Lond B Biol Sci* 368:20120144
- Bush S, Hopkins A (2011) Public–private partnerships in neglected tropical disease control: the role of nongovernmental organisations. *Acta Trop* 120:S169–S172
- Conteh L, Engels T, Molyneux DH (2010) Socioeconomic aspects of neglected tropical diseases. *Lancet* 375:239–247
- Damme WV, Leemput LV, Hardeman W, Meessen B (2004) Out-of-pocket health expenditure and debt in poor households: evidence from Cambodia. *Trop Med Int Health* 9:273–280
- Dans A, Ng N, Varghese C, Tai ES, Firestone R, Bonita R (2011) The rise of chronic non-communicable diseases in southeast Asia: time for action. *Lancet* 377:680–689
- Das JK, Salam RA, Arshad A, Maredia H, Bhutta ZA (2014) Community based interventions for the prevention and control of non-helminthic NTD. *Infect Dis Poverty* 3:24
- De S (2011) Prevalence of depression in stable chronic obstructive pulmonary disease. *Indian J Chest Dis Allied Sci* 53:35–39
- Dhillon PK, Jeemon P, Arora NK, Mathur P, Maskey M, Sukirna RD, Prabhakaran D (2012) Status of epidemiology in the WHO South-East Asia region: burden of disease, determinants of health and epidemiological research, workforce and training capacity. *Int J Epidemiol* 41:847–860

- Ebrahim S, Kinra S, Bowen L, Andersen E, Ben-Shlomo Y, Lyngdoh T, Ramakrishnan L, Ahuja R, Joshi P, Das SM (2010) The effect of rural-to-urban migration on obesity and diabetes in India: a cross-sectional study. *PLoS Med* 7:e1000268
- Engelgau M, Rosenhouse S, El-Saharty S, Mahal A (2011) The economic effect of noncommunicable diseases on households and nations: a review of existing evidence. *J Health Commun* 16(Suppl 2):75–81
- GBD 2016 DALYs and HALE Collaborators (2017) Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 390:1260–1344
- Glazier RH, Bajcar J, Kennie NR, Willson K (2006) A systematic review of interventions to improve diabetes care in socially disadvantaged populations. *Diabetes Care* 29:1675–1688
- Global Health Progress (2013) Action on neglected tropical diseases in India. New Delhi
- Gupta R, Gupta V, Sarna M, Prakash H, Rastogi S, Gupta K (2003) Serial epidemiological surveys in an urban Indian population demonstrate increasing coronary risk factors among the lower socioeconomic strata. *J Assoc Phys India* 51:470–477
- Hathirat P, Valyasevi A, Kotchabhakdi NJ, Rojroongwasinkul N, Pollitt E (1992) Effects of an iron supplementation trial on the Fe status of Thai schoolchildren. *Br J Nutr* 68:245–252
- Hengrasme P, Padungsutt P, Boriboonthirunarn D (2004) Depression among gynecologic cancer patients at Siriraj Hospital: prevalence and associated factors. *J Med Assoc Thai* 87(Suppl 3): S74–S79
- Hofstraat K, van Brakel WH (2016) Social stigma towards neglected tropical diseases: a systematic review. *Int Health* 8(Suppl 1):i53–i70
- Hotez PJ, Daar AS (2008) The CNCDs and the NTDs: blurring the lines dividing noncommunicable and communicable chronic diseases. *PLoS Negl Trop Dis* 2:e312
- Hotez PJ, Fenwick A, Savioli L, Molyneux DH (2009) Rescuing the bottom billion through control of neglected tropical diseases. *Lancet* 373:1570–1575
- Hotez PJ, Alvarado M, Basáñez M-G, Bolliger I, Bourne R, Boussinesq M, Brooker SJ, Brown AS, Buckle G, Budke CM (2014) The global burden of disease study 2010: interpretation and implications for the neglected tropical diseases. *PLoS Negl Trop Dis* 8:e2865
- Indian Institute of Population Sciences and Ministry of Health and Family Welfare, Government of India (2010) Global adult tobacco survey, India 2009–2010. New Delhi
- Institute of Health Metrics and Evaluation (2016) Global burden of disease. <http://www.vizhub.healthdata.org/gbd-compare>. Retrieved 22 Dec 2017
- Jacobs B, Ir P, Bigdeli M, Annear PL, Van Damme W (2012) Addressing access barriers to health services: an analytical framework for selecting appropriate interventions in low-income Asian countries. *Health Policy Plan* 27:288–300
- Jeemon P, Reddy K (2010) Social determinants of cardiovascular disease outcomes in Indians. *Indian J Med Res* 132(5):617
- Kassi M, Kassi M, Afghan AK, Rehman R, Kasi PM (2008) Marring leishmaniasis: the stigmatization and the impact of cutaneous leishmaniasis in Pakistan and Afghanistan. *PLoS Negl Trop Dis* 2:e259
- Kotwani A (2009) Availability, price and affordability of asthma medicines in five Indian states. *Int J Tuberc Lung Dis* 13:574–579
- Krentel A, Damayanti R, Titaly CR, Suharno N, Bradley M, Lynam T (2016) Improving coverage and compliance in mass drug administration for the elimination of LF in two ‘Endgame’ districts in Indonesia using micronarrative surveys. *PLoS Negl Trop Dis* 10:e0005027
- Lenk EJ, Redekop WK, Luyendijk M, Rijnsburger AJ, Severens JL (2016) Productivity loss related to neglected tropical diseases eligible for preventive chemotherapy: a systematic literature review. *PLoS Negl Trop Dis* 10:e0004397
- Liese B, Rosenberg M, Schratz A (2010) Programmes, partnerships, and governance for elimination and control of neglected tropical diseases. *Lancet* 375:67–76

- Litt E, Baker MC, Molyneux D (2012) Neglected tropical diseases and mental health: a perspective on comorbidity. *Trends Parasitol* 28:195–201
- Lobo DA, Velayudhan R, Chatterjee P, Kohli H, Hotez PJ (2011) The neglected tropical diseases of India and South Asia: review of their prevalence, distribution, and control or elimination. *PLoS Negl Trop Dis* 5:e1222
- Lueboonthavatchai P (2007) Prevalence and psychosocial factors of anxiety and depression in breast cancer patients. *J Med Assoc Thai* 90:2164–2174
- Mahal A, Karan A, Engelgau M (2010) The economic implications of non-communicable disease for India. World Bank, Washington, DC
- Mavalankar D, Puwar TI, Murtola TM, Vasan S (2009) Quantifying the impact of chikungunya and dengue on tourism revenues. Indian Institute of Management
- Mendis S, Fukino K, Cameron A, Laing R, Filipe A Jr, Khatib O, Leowski J, Ewen M (2007a) The availability and affordability of selected essential medicines for chronic diseases in six low- and middle-income countries. *Bull World Health Organ* 85:279–288
- Mendis S, Lindholm LH, Mancia G, Whitworth J, Alderman M, Lim S, Heagerty T (2007b) World Health Organization (WHO) and International Society of Hypertension (ISH) risk prediction charts: assessment of cardiovascular risk for prevention and control of cardiovascular disease in low and middle-income countries. *J Hypertens* 25:1578–1582
- Mensah G, Mayosi B (2013) The 2011 United Nations high-level meeting on non-communicable diseases: the Africa agenda calls for a 5-by-5 approach. *S Afr Med J* 103:77–79
- Miguel E, Kremer M (2004) Worms: identifying impacts on education and health in the presence of treatment externalities. *Econometrica* 72:159–217
- Molyneux DH (2012) The ‘neglected tropical diseases’: now a brand identity; responsibilities, context and promise. *Parasit Vectors* 5:23
- Molyneux DH (2014) Neglected tropical diseases: now more than just ‘other diseases’—the post-2015 agenda. *Int Health* 6:172–180
- Moolani Y, Bukhman G, Hotez PJ (2012) Neglected tropical diseases as hidden causes of cardiovascular disease. *PLoS Negl Trop Dis* 6:e1499
- Muniaraj M (2014) The lost hope of elimination of Kala-azar (visceral leishmaniasis) by 2010 and cyclic occurrence of its outbreak in India, blame falls on vector control practices or co-infection with human immunodeficiency virus or therapeutic modalities? *Trop Parasitol* 4:10
- Mustapha FI, Omar ZA, Mihati O, Noh KM, Hassan N, Bakar RA, Manan AA, Ismail F, Jabbar NA, Muhamad Y (2014) Addressing non-communicable diseases in Malaysia: an integrative process of systems and community. *BMC Public Health* 14(Suppl 2):S4
- Na-Bangchang K, Kietinun S, Pawa KK, Hanpitakpong W, Na-Bangchang C, Lazdins J (2006) Assessments of pharmacokinetic drug interactions and tolerability of albendazole, praziquantel and ivermectin combinations. *Trans R Soc Trop Med Hyg* 100:335–345
- Narain JP, Dash AP, Parnell B, Bhattacharya SK, Barua S, Bhatia R, Savioli L (2010) Elimination of neglected tropical diseases in the South-East Asia Region of the World Health Organization. *Bull World Health Organ* 88:206–210
- Narain JP, Garg R, Fric A (2011) Non-communicable diseases in the South-East Asia region: burden, strategies and opportunities. *Natl Med J India* 24:280
- Nations Online Project (2014) World population by continents. [http://www.nationsonline.org/oneworld/world\\_population.htm](http://www.nationsonline.org/oneworld/world_population.htm). Retrieved 4 Dec 2014
- Nawaz F (2014) Bangladesh leads the way in combating kala-azar. <http://www.icddrb.org/media-centre/feature/bangladesh-leads-the-way-in-combating-kala-azar>. Retrieved 20 Dec 2014
- Nguyen Q, Pham S, Nguyen V, Weinehall L, Wall S, Bonita R, Byass P (2012) Effectiveness of community-based comprehensive healthy lifestyle promotion on cardiovascular disease risk factors in a rural Vietnamese population: a quasi-experimental study. *BMC Cardiovasc Dis* 12:56
- Nidhinandana S, Chinvarun Y, Sithinamsuwan P, Udommongkol C, Suwantamee J, Wongmek W, Suphakasem S (2007) Prevalence of depression among epileptic patients at Phramongkutklao Hospital. *J Med Assoc Thai* 90:32–36



- Padmavati R (2005) Community mental health care in India. *Int Rev Psychiatry* 17:103–107
- Patel V, Weiss HA, Chowdhary N, Naik S, Pednekar S, Chatterjee S, De Silva MJ, Bhat B, Araya R, King M, Simon G, Verdelli H, Kirkwood BR (2010) Effectiveness of an intervention led by lay health counsellors for depressive and anxiety disorders in primary care in Goa, India (MANAS): a cluster randomised controlled trial. *Lancet* 376:2086–2095
- Perera M, Whitehead M, Molyneux D, Weerasooriya M, Gunatilleke G (2007) Neglected patients with a neglected disease? A qualitative study of lymphatic filariasis. *PLoS Negl Trop Dis* 1:e128
- Petney TN (2001) Environmental, cultural and social changes and their influence on parasite infections. *Int J Parasitol* 31:919–932
- Phuc TQ, Mihrshahi S, Casey GJ, Phu LB, Tien NT, Caruana SR, Thach TD, Montresor A, Biggs B-A (2009) Lessons learned from implementation of a demonstration program to reduce the burden of anemia and hookworm in women in Yen Bai Province, Viet Nam. *BMC Public Health* 9:266
- Prabhakaran D, Jeemon P, Goenka S, Lakshmy R, Thankappan KR, Ahmed F, Joshi PP, Mohan BVM, Meera R, Das MS, Ahuja RC, Saran RK, Chaturvedi V, Reddy KS (2009) Impact of a worksite intervention program on cardiovascular risk factors: a demonstration project in an Indian Industrial Population. *J Am Coll Cardiol* 53:1718–1728
- Ramaiah KD, Radhamani MP, John KR, Evans DB, Guyatt H, Joseph A, Datta M, Vanamail P (2000) The impact of lymphatic filariasis on labour inputs in southern India: results of a multi-site study. *Ann Trop Med Parasitol* 94:353–364
- Ramaiah K, Vijay Kumar K, Chandrakala A, Augustin D, Appavoo N, Das P (2001) Effectiveness of community and health services-organized drug delivery strategies for elimination of lymphatic filariasis in rural areas of Tamil Nadu, India. *Trop Med Int Health* 6:1062–1069
- Rani M, Nusrat S, Hawken LH (2012) A qualitative study of governance of evolving response to non-communicable diseases in low-and middle- income countries: current status, risks and options. *BMC Public Health* 12:877
- Rao S, Garole V, Walawalkar S, Khot S, Karandikar N (1996) Gender differentials in the social impact of leprosy. *Lepr Rev* 67:190–199
- Rao KD, Bhatnagar A, Murphy A (2011) Socio-economic inequalities in the financing of cardiovascular & diabetes inpatient treatment in India. *Indian J Med Res* 133:57–63
- Reddy KS, Prabhakaran D, Jeemon P, Thankappan K, Joshi P, Chaturvedi V, Ramakrishnan L, Ahmed F (2007) Educational status and cardiovascular risk profile in Indians. *Proc Natl Acad Sci USA* 104:16263–16268
- Reithinger R, Aadil K, Kolaczinski J, Mohsen M, Hami S (2005) Social impact of leishmaniasis, Afghanistan. *Emerg Infect Dis* 11:634–636
- Salam RA, Maredia H, Das JK, Lassi ZS, Bhutta ZA (2014) Community-based interventions for the prevention and control of helminthic neglected tropical diseases. *Infect Dis Poverty* 3:23
- Schmidt LA, Makela P, Rehm J, Room R (2010) Alcohol: equity and social determinants. World Health Organization, Geneva
- Srivastava R, Bachani D (2011) Burden of NCDs, policies and programme for prevention and control of NCDs in India. *Indian J Commun Med* 36(Suppl 1):S7
- Srivastava P, Bhattacharjee J, Dhariwal A, Krishnamoorthy K, Dash A (2014) Elimination of lymphatic filariasis—current status and way ahead. *J Commun Dis* 46:85–94
- Sudomo M, Chayabejara S, Duong S, Hernandez L, Wu WP, Bergquist R (2010) Elimination of lymphatic filariasis in Southeast Asia. *Adv Parasitol* 72:205–233
- Tamil Nadu Health Systems Project (2012) Tamil Nadu health systems project – focus areas. <http://www.tnhsp.org/focus-areas>. Retrieved 15 Nov 2014
- Tan M, Kusriastuti R, Savioli L, Hotez PJ (2014) Indonesia: an emerging market economy beset by neglected tropical diseases (NTDs). *PLoS Negl Trop Dis* 8:e2449
- Thankappan KR, Mini GK, Daivadanam M, Vijayakumar G, Sarma PS, Nichter M (2013) Smoking cessation among diabetes patients: results of a pilot randomized controlled trial in Kerala, India. *BMC Public Health* 13:47



- Uranw S, Meheus F, Baltussen R, Rijal S, Boelaert M (2013) The household costs of visceral leishmaniasis care in south-eastern Nepal. *PLoS Negl Trop Dis* 7:e2062
- Vlassoff C, Manderson L (1998) Incorporating gender in the anthropology of infectious diseases. *Trop Med Int Health* 3:1011–1019
- Watts SJ (1987) Population mobility and disease transmission: the example of Guinea worm. *Soc Sci Med* 25:1073–1081
- Weiss MG (2008) Stigma and the social burden of neglected tropical diseases. *PLoS Negl Trop Dis* 2:e237
- World Health Assembly (1991) Elimination of leprosy: resolution of the 44th World Health Assembly (WHA 44/1991/ REC/9). World Health Organization, Geneva
- World Health Assembly (1997) Elimination of lymphatic filariasis as a public health problem: resolution of the 50th World Health Assembly (WHA 55/1997/REC/20). World Health Organization, Geneva
- World Health Organization (2011) Global status report on non-communicable diseases 2010. World Health Organization, Geneva
- World Health Organization (2013) Sustaining the drive to overcome the global impact of neglected tropical diseases: second WHO report on neglected diseases. World Health Organization, Geneva
- World Health Organization (2014) Global status report on non-communicable diseases. WHO, Geneva
- World Health Organization, Husada B (2011) Neglected tropical diseases in Indonesia: an integrated plan of action. Ministry of Health of Indonesia, 2011–2015
- World Health Organization Regional Office for South-East Asia (2006) Report of the 59th session of the Regional Committee of the South-East Asia Region. World Health Organization, New Delhi
- Xianyi C (2002) The challenges and strategies in schistosomiasis control program in China. *Acta Trop* 82:279–282
- Xiao N, Long Q, Tang X, Tang S (2014) A community-based approach to non-communicable chronic disease management within a context of advancing universal health coverage in China: progress and challenges. *BMC Public Health* 14(Suppl 2):S2
- Yusuf S, Islam S, Chow CK, Rangarajan S, Dagenais G, Diaz R, Gupta R, Kelishadi R, Iqbal R, Avezum A, Kruger A, Kutty R, Lanas F, Lisheng L, Wei L, Lopez-Jaramillo P, Oguz A, Rahman O, Swidan H, Yusoff K, Zatonski W, Rosengren A, Teo KK (2011) Use of secondary prevention drugs for cardiovascular disease in the community in high-income, middle-income, and low-income countries (the PURE Study): a prospective epidemiological survey. *Lancet* 378:1231–1243
- Zodpey SP, Tiwari RR, Salodkar AD (2000) Gender differentials in the social and family life of leprosy patients. *Lepr Rev* 71:505–510