Chapter - 4

General approach to estimation of epidemiological inputs for computation of National Burden of Disease.

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The disability part of disease burden (YLD) estimate is computed from descriptive epidemiology and disability weights attached to respective diseases. Assignment of disability weights to various health states are dealt in the subsequent two chapters. The process of arriving at the descriptive epidemiology is discussed here. Descriptive epidemiology of a disease include its incidence, prevalence, age at onset, duration and / or remission rates. If the disease is characterized by fatality then case fatality rates are also included in its descriptive epidemiology. Some of these parameters are required as inputs to computation of YLDs. Others are required to check internal consistency of the epidemiological parameters themselves and with cause of death estimates as well (Murray and Lopez 1994, 1996). Ideally a NBD study should incorporate locally anchored descriptive epidemiology of potentially top causes of disease burden in the concerned country or state. We did start the process with such an aim. After pursuing for about one year, we realised that the descriptive epidemiologic database in India is not so easily forthcoming. Although a large number of biomedical researchers are working on most of the diseases recognized to be of national importance, the emphasis on descriptive epidemiology is lacking. The GBD study already provides descriptive epidemiology estimates for India. Hence, I decided to adopt the GBD 1996 estimates as such, and hope that in future more specific information will be available to facilitate state level estimates. In this chapter I outline the steps required to anchor NBD estimates to local epidemiological situation. These are; (a) setting priority for estimation of descriptive epidemiology, (b) general approach to generating disease specific estimates for a Burden of Disease study, and (c) criteria to assess the level of anchorage to local data, and (d) the need for local capacity in descriptive epidemiology. To facilitate further work on generating descriptive epidemiology estimates for NBD studies, a case study of estimating descriptive epidemiology of tuberculosis in rural areas on Andhra Pradesh has been prepared. This is present presented in the following chapter.

Setting priority for estimation of descriptive epidemiology:

The global burden of disease study included 132 entities of premature mortality, disease or injury and 483 sequelae. Deriving local epidemiological estimates for all these entities will be impractical and is unnecessary for policy analytic purposes. Constraints for full scale estimation for all conditions are; (a) lack of local data of any sort for rarer conditions, (b) lack of epidemiological expertise for rarer conditions, and (c) additional time commitments. From a policy analytic perspective it would be cost-effective to tolerate a higher degree of error in estimates for conditions known to be rare, since they would normally not come up for considerations in policy debate. So an optimal strategy would be to identify the most common sources of disability in the country or state concerned and make locally based epidemiological estimates for them. For the remaining conditions latest GBD estimates for the concerned region, can be adopted as such or with minor but obvious modifications.

The general approach of choosing a limited but important set of diseases for detailed study, may not be so much controversial as choice of the limited set itself. How do we identify the important causes of disability say in AP, before estimating their incidence or prevalence? Latest GBD estimates for India can be used here. To identify potentially top causes of disability in Andhra Pradesh, we look at the YLDs by cause in India. The potential importance of a cause can be assessed by the proportion of total YLDs in India accounted for by it. Other sources of information about potentially important disabling conditions include; (a) diseases for which some control program is under implementation, and (b) consensus opinion of public health experts. Before setting out to identify the potentially top causes of disability it would be useful to spell out some explicit criteria. I propose the following as a starting point.

1. Account for more than two thirds of disability burden,
2. Include all diseases for which specific control program or such other public health intervention is currently in place, and
3. Not omit diseases accounting for more YLDs than any other disease included in the list.

Table-4.1 Group-1 conditions contributing more than 100,000 YLDs to disease burden in India and number of published articles from India in two medical and health bibliographical data bases.

Cause	YLDs	Search string	MEDLINE87-97		Health Star75-96	
			World	India	World	India
Tuberculosis	1,199	Tuberculosis or TB	9,840	124	7,854	105
Syphilis	239					
Chlamydia	2,014	Chlamydia	2,925	3	2,046	2
Gonnorhoea	1,394	gonorrhea or gonorrhoea	934	2	1,277	2
Diarhoeal diseases	923	Diarrhoea or diarrhea	9,477	126	8,349	91
Pertusis	306	Pertusis or whooping cough	187	0	301	0
Poliomyelitis	951	Poliomyelitis	957	29	1,038	35
Bacterial meningitis	325	Meningitis	5,352	38	4,032	34
Malaria	425	Malaria	5,511	119	3,789	106
Lymphatic filariasis	1,770	Filariasis	899	60	568	43
Leprosy	173					
Ascariasis	148					
Trichuriasis	104					
Ancylostomiasis and necatoriasis	436	Hookworm or ancylo-stomiasis or necatoriasis	312	6	341	8
Otitis media	233					
Maternal sepsis	725	Maternal sepsis	7	0	8	0
Obstructed labour	1,236	Obstructed labour	43	1	42	1
Abortion	1,106	Abortion	4,301	12	5,645	26
PEM	3,005	Protein energy malnutrition	354	5	382	7
Iodine deficiency	175					
Iron def. anaemia	5,349	Anaemia and iron deficiency	4,903	4	789	3

Table - 4.2: Group -2 diseases contributing more than 100,000 YLDs to disease burden in India and number of articles from India in two medical and health bibliographical data bases.

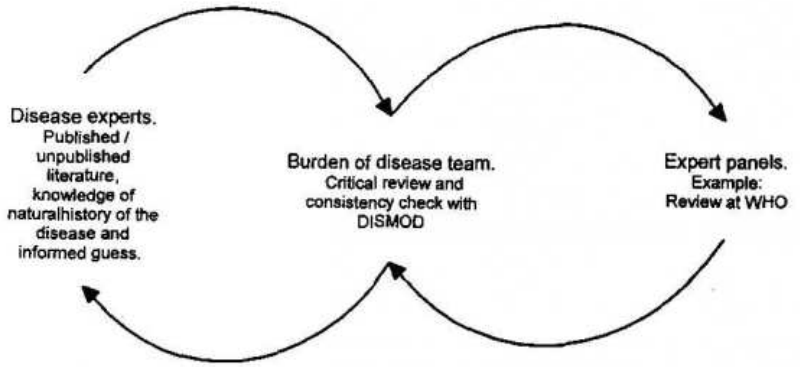
Cause	YLDs	Search string	MEDLINE87-97		Health Star75-96	
			World	India	World	India
Cancer mouth & oropharynx	145					
Diabetes melitus	866	Diabetes	27,922	92	21,490	82
Unipolar depression	8,063	Depression	35,709	26	26,829	27
Bipolar depression	2,285	Depression	35,709	26	26,829	27
Schizophrenia	1,600	Schizophrenia	8,265	23	7,995	25
Epilepsy	668	Epilepsy	7,137	29	5,349	22
Alcohol use	825	Alcohol use or alcohol dependence	20,650	51	25,128	63
Dementia	803	Dementia	8,139	7	5,574	4
Parkinsons disease	104					
Multiple sclerosis	165					
Post-traumatic stress	316	Post traumatic stress	643	0	549	0
Obsessive compulsive dis.	1,640	Obsessive compulsive	1,586	2	1,104	3
Panic disorder	738	Panic disorder	1,891	1	1,251	1
Glaucoma	573	Glaucoma	4,055	9	4,098	8
Cataract	2,439	Cataract	4,414	60	4,625	54
Rheumatic heart dis.	152					
IHD	1,281	Ischaemic heart disease or IHD	1,700	8	1,994	10
Cerebrovascular dis.	651	Cerebrovascular disease or stroke	13,460	14	12,436	12
Inflamatory heart dis.	420	Inflamatory heart disease	0	0	0	0
COPD	1,257	COPD or chronic obstructive pulmonary disease or chronic bronchitis	3,739	6	3,916	10
Asthma	1,251	Asthma	13,234	15	11,022	10
Peptic ulcer	338	Peptic ulcer	2,460	13	2,256	12
Cirhosis of the liver	551	Cirrhosis and liver	6,308	23	4,650	21
Nephritis and nephrosis	107					
Benign prostatic hypertrophy	264					
Rheumatoid arthritis	160					
Osteoarthritis	1,218	Osteoarthritis	3,201	1	2,360	1
Down syndrome	580	Down syndrome	1,613	2	1,057	2
Congenital heart anomalies	1,458	Congenital heart disease	2,047	5	2,116	6
Spina bifida	655	Spina bifida	800	2	950	1
Dental caries	672	Dental caries	1,241	5	1,719	7
Edentulism	289					

Out of the estimated 87680 thousand YLDs in India the top 59 causes (Tables - 4.1-4.3) accounted for 85.11% (i.e. 74626,000) which includes all causes responsible for 100 thousand or more YLDs. If the top causes of disability were restricted to more than 500 thousand YLDs the number of conditions would reduce to 42, while still accounting for about 79% (69254) of total disability estimate for India. However some diseases currently identified to be of public health importance in AP, namely malaria, iodine deficiency and leprosy would be excluded. Users of the burden of disease estimates for AP would naturally be interested to know the relative importance of currently identified problem areas. Hence further reducing the 59 potentially top causes of disability to save analytical effort may not be advisable.

Disease specific estimates:

The process by which disease specific epidemiological estimates were obtained for the GBD study has been described by Murray and Lopez (1994, 1996). It starts with identification of disease specific experts who generate a set of initial estimates. Murray and Lopez (1996) inform about the geographic spread of disease experts, probably to signal the need for a broad based college of experts and an extensive search process. Disease experts are expected to base their estimates on published and unpublished data. They are encouraged, in addition, to make informed guess. Initial estimates from disease experts are then critically reviewed by the burden of disease estimation team and fed back to the disease experts. The critical review includes plausibility as well as internal consistency of the estimated epidemiological parameters. Plausibility refers to agreement of estimates with common knowledge about the disease, its time trend and relationship to other diseases. Consistency refers to agreement of estimates of interdependent parameters. For example, incidence and duration, largely determine prevalence. The level of incidence, and case fatality, largely determines the cause specific death rate. Internal consistency is checked with the help of a disease modeling computer software called DISMOD. Theoretical basis of the disease model (DISMOD) have also been described by Murray and Lopez (1996). Disease experts either re-estimate the epidemiological parameters in the light of the critical review or supply their arguments to support the original estimates. This cycle of estimation, consistency check followed by re-estimation is repeated a few times till the estimates of disease experts converge within the bounds of plausibility and internal consistency set by the burden of disease estimation team (Figure - 4.1). Estimates for all or major groups of diseases are then presented, by the burden of disease estimation team, to one or more broad based panels of health experts for review. At this stage the reviewers' focus would be on plausibility and consistency with respect to estimates for other related diseases. Such concerns articulated by the reviewers are fed into a further round of iteration between the burden of disease estimation team and disease specific experts.

Figure-4.1 Basic frame work to generate descriptive epidemiological estimates for GBD



Note that the basic approach is to indirectly estimate a complete set of descriptive epidemiological parameters using data which are available in bits and pieces at best, knowledge about natural history of the disease and a general disease model (DISMOD).

Key step in the above process is the initial estimate made by disease experts. The first estimate sets the ground for further review. Details of this estimation - review - re-estimation cycle has been described. But specific guidance for disease experts to arrive at the initial estimate itself is lacking. Murray and Lopez (1996) have mentioned three instructions to disease experts, namely (a) use published and unpublished sources of data, (b) assume similar age pattern, but not necessarily the same level of incidence and remission across regions, if no local data to the contrary is available and (c) make informed guess. Disease experts are uncomfortable with the idea of guessing epidemiological estimates in the absence of corresponding statistics. When they are willing to undertake such an exercise, they would usually want to have some guidelines to arrive at the first estimate. Murray (1994, 1996) has referred to the difference in attitude of demographers and epidemiologists to indirect estimation. The difference in attitude is there for good reasons. Epidemiologists are traditionally concerned with investigation of causative relationships, which certainly do not give scope for any informed guess. Inferences about causative relationships have to be based on refutable hypotheses that are amenable to statistical testing. Although epidemiologist do undertake descriptive work to inform health policy and planning, there is usually the freedom in choice of statistic to describe the problem at hand. Accordingly different problems are described using different statistic considered appropriate for the specific disease at hand. Burden of disease estimation, however, requires estimates for all diseases using one standard set of statistics. For example malaria experts usually measure

intensity of the disease by annual parasite index (API). Though this is an incidence like measure it is not exactly the incidence. The API will depend on the actual incidence, number of slides collected from a person during the same episode etc. The API has served malaria control programmes well enough to monitor time trend of malaria. The index, however, is inadequate for comparison of morbidity across various causes.

Table-4.3 Accidents and injuries contributing more than 100,000 YLDs to disease burden in India and number of articles from India in two medical and health bibliographical data bases.

Cause	YLDs	Search string	MEDLINE87-97		Health Star75-96	
			World	India	World	India
Road traffic accidents	1,375	Road traffic accident	108	0	98	0
Falls	9,046	Falls and injury	888	1		
Fires	2,115	Fire	1,114	3	1,440	3
Other unintentional	6,972	Accidents	3,666	11	5,186	14
Self inflicted injuries	166					
Violence	182					

Published epidemiological literature is an important source of information to generate the required estimates for these diseases (see Figure-4.1 earlier). To get a quick feel of the extent to which publications relating to India on these 59 potentially top causes of disability would be available two medical and health data bases (MEDLINE 1987-1997 and Healthstar 1975-1996) were searched. First the total number of English language publications on humans containing relevant key words were found. This result was then combined with the key word "India" to get the number of publications relating to India. Tables 4.1-3 show the number publications for the world and those relating to India. Note that results of this search would include articles dealing with all aspects of the respective diseases. Publications dealing directly or indirectly with descriptive epidemiology of the respective diseases will be a very small subset of the search result now obtained. The result gives an upper bound for published epidemiological literature relating to India. Subject to these limitations some very broad inferences can be made. Disease with some publications relating to India are (1) alcohol use, (2) cataract, (3) diabetes, (4) diarrhoea, (5) filariasis, (6) malaria, and (7) tuberculosis. Little publication is being generated on psychiatric conditions like post traumatic stress disorder (PTSD), obsessive compulsive disorder, panic disorder, and dementia. So is the case with injuries including road traffic accidents, falls, fires and other unintentional injuries. Publications relating to India for other conditions in the potentially top cause list are very few.

Table-4.4: Coverage of top causes of YLDs by ongoing disease control programmes in AP

Disease	Activity in AP
Tuberculosis	National Tuberculosis Control Programme (NTCP)
Syphilis	National STD control program
Chlamydia	National STD control program
Gonorrhea	National STD control program
Other STD's	National STD control program
HIV	AIDs control program to (a) ensure safe blood transfusion; (b) develop policy on indications for blood transfusion and fixing criteria for selection of blood donors and their acceptability; and (c) strengthen and further develop blood transfusion servi
Diarrhoeal diseases	Oral rehydration therapy component of CSSM programme to create awareness among mothers regarding quick replacement of fluids lost due to diarrhoea. Timely referral based on severity is also an integral component
Tetanus	Tetanus immunization of mothers under CSSM.
Malaria	National Malaria Eradication Programme (NMEP)
Lymphatic filariasis	National filariasis control program
Leprosy	National leprosy control programme (NLEP)
ALRI	acute respiratory infections control under CSSM
Maternal hypertension	Identification of high risk expectant mothers and providing referral services under CSSM
Obstructed labor	Identification of high risk expectant mothers and providing referral services under CSSM
Iodine deficiency	Goitre control program
Vitamin A deficiency	Vit-A supplementation under the National program for prevention and control of blindness.
Iron-deficiency	Iron & folic acid supplementation under CSSM
anaemia	Nutritional Anaemia Control Programme (NNACP): supply of iron and folic acid to children less than 12 years, expectant and lactating women and family planning acceptors.
Diabetes mellitus	National diabetes control program.
Cataracts	National program for prevention and control of blindness.

Another source of epidemiological information would be unpublished data particularly from various disease control programs and public health intervention activities. Table-4.4 shows a list of 19 diseases, from the potentially top causes of YLD list, with some ongoing control program in AP. Six of seven diseases mentioned with some published literature, are included in this. These are cataract, diabetes, diarrhea, filariasis, malaria and tuberculosis. The data base for epidemiological estimates of these six conditions is likely to be fair. Four diseases are included in the sexually transmitted disease (STD) control program, namely; syphilis, chlamydia, gonorrhea and others. Since the STD control program is largely hospital based, population based statistics about incidence or prevalence of these conditions may not be generated by the program. For other conditions in this list some unpublished data can be expected, although it is difficult to predict their usability.

Criteria to assess the level of anchorage to local data:

The question of anchoring the indirect estimation procedures to local reality still remains. Suppose we have made the most out of published or unpublished literature and expert opinion. Is that enough? Can we reasonably be sure of the epidemiological estimates for policy analytic purposes? The ideal solution would be to collect primary data by undertaking cross sectional studies and / or longitudinal studies to measure prevalence and incidence respectively. However resources may not be readily available to undertake such studies to feed into burden of disease estimation right away. The next best alternative would be to (a) identify, prioritize and report data gaps so that research, monitoring and evaluation studies may address them in future and (b) identify the causes of disability by the extent to which their estimates are anchored to local data so that policy makers can take it into consideration while debating implications of burden of disease estimates. In either case there is a need to develop some criteria to judge if the local anchorage of disease burden estimate is adequate. The following criteria are proposed.

1. Does the secondary data used for indirect estimation relate to the same population for which the burden of disease estimates are made or at least to a closely related population. For example do the published and unpublished data relate to Andhra Pradesh (the same population) a closely related population (other states in India with similar mortality and fertility levels) or neighbouring countries, and
2. How many of the age sex specific estimate points of either prevalence or incidence reflect local data i.e. the same population or

closely related population. The GBD study estimated YLD by ten age sex groups consisting of five age (0-4, 5-14, 15-44, 45-59, and 60+) year groups for each sex. Hence, there should be at least ten age, sex specific local data points in incidence-prevalence.

Building National capacity in descriptive epidemiology:

The GBD frame work of epidemiological estimation (Figure-4.1) envisages use of expert opinion, to fill in persistent gaps in data after taking into account published and unpublished sources. The expertise to generate informed guesses for a NBD study consists of knowledge about (a) natural history of the disease, particularly the age pattern of its incidence or prevalence, (b) how environmental factors may affect the level of its incidence or prevalence and (c) environmental characteristic of the country or state in question. This means that a very active search for epidemiological expertise about the potentially top causes of disability in India will have to be made. The APBD team had sent out letters to all Indian Council of Medical Research (ICMR) laboratories and research institutions in 1994 inviting experts who may be interested to collaborate for estimations relating to specific diseases of their interest. Although there was a lot of curiosity to start with, very few experts were finally forthcoming for this exercise. One possible reason may be, lack of familiarity with burden of disease estimation, which had just appeared about a year before these letters were mailed out. Another reason might have been lack of more detailed guidelines to arrive at the initial epidemiological estimates. The most important contributing factor, I think was the general lack of emphasis on descriptive epidemiology. Analytic epidemiology is usually more exciting and better appreciated among biomedical researchers. In the absence of awareness and inclination among health policy makers to use evidence and information for policy, the motivation level for descriptive epidemiology would be low. It is heartening to note that, as of 2001, the ICMR has recognized the need to strengthen National capacity in descriptive epidemiology and decided to launch burden of disease studies through all its laboratories. Such institution wide movement, it is hoped will improve the availability of descriptive epidemiological data for estimation of disease burden and other health priority setting exercises.

References

1. Murray Christopher J.L. and Lopez Alan D.; 1996; Global and regional descriptive epidemiology of disability: incidence, prevalence, health expectancies and years lived with disability. Murray Christopher J.L. and

Lopez Alan D., Editors. The global burden of disease. A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Boston: Harvard School of Public Health.

2. Murray Christopher J.L and Lopez Alan D.; 1994; Quantifying disability: data, methods and results.: Murray Christopher J.L. and Lopez Alan D., Editors. Global comparative assessments in the health sector: disease burden, expenditures and intervention packages. Collected reprints from the Bulletin of the World Health Organization. Geneva: WHO.

3. Murray Christopher J.L.; 1996; Rethinking DALYs. in: Murray Christopher J.L. and Lopez Alan D., Editors. The global burden of disease. A comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Boston: Harvard School of Public Health; 1996.

4. Murray Christopher J.L.; 1994; Quantifying the burden of disease: the technical basis for disability-adjusted life years. in: Murray Christopher J.L. and Lopez Alan D., Editors. Global comparative assessments in the health sector: disease burden, expenditures and intervention packages. Collected reprints from the Bulletin of the World Health Organization. Geneva.