Indian J Med Res 127, April 2008, pp 347-361

Cost of illness: Evidence from a study in five resource-poor locations in India

David M. Dror, Olga van Putten-Rademaker* & Ruth Koren**

*Institute for Health Policy & Management, Erasmus University Rotterdam/MC, Netherlands; & Micro Insurance Academy, New Delhi, India, *Institute for Public Sector Efficiency Studies (IPSE), Faculty of Technology, Policy & Management, Delft University of Technology, GA Delft, The Netherlands & **The Sackler Faculty of Medicine, Tel Aviv University, Israel*

Received August 14, 2007

***Background & objectives*: In India, health services are funded largely through out-of-pocket spendings (OOPS). We carried out this study to collect data on the cost of an illness episode and parameters affecting cost in five locations in India.**

***Methods*: The data were obtained through a household survey carried out in 2005 in five locations among resource-poor persons in rural India. The analysis was based on self-reported illness episodes and their costs. The study was based on 3,531 households (representing 17,323 persons) and 4,316 illness episodes.**

***Results*: The median cost of one illness episode was INR 340. When costs were calculated as per cent of monthly income per person, the median value was 73 per cent of that monthly income, and could reach as much as 780 per cent among the 10 per cent most exposed households. The estimated median per-capita cost of illness was 6 per cent of annual per-capita income. The ratio of direct costs to indirect costs was 67:30. The cost of illness was lower among females in all age groups, due to lower indirect costs. 61 per cent of total illnesses, costing 37.4 per cent of total OOPS, were due to acute illnesses; chronic diseases represented 17.7 per cent of illnesses but 32 per cent of costs. Our study showed that hospitalizations were the single most costly component on average, yet accounted for only 11 per cent of total on an aggregated basis, compared to drugs that accounted for 49 per cent of total aggregated costs. Locations differed from each other in the absolute cost of care, in distribution of items composing the total cost of care, and in supply.**

***Interpretation & conclusions*: Interventions to reduce the cost of illness should be context-specific, as there is no "one-size-fits-all" model to establish the cost of healthcare for the entire sub-continent. Aggregated expenses, rather than only hospitalizations, can cause catastrophic consequences of illness.**

Key words Cost of illness - direct health expenditures - India - indirect health expenditures - health expenditures - rural population

In view of the limited resources that can be spent on healthcare in India – by the government or by individuals – rationing is inevitable. In India today, health services are provided mainly by private providers[1-3] and funded largely through out-of-pocket spending of care-seekers (OOPS) when healthcare delivery occurs[4,5]. This situation is recognized both as inequitable[6-8] and as a serious impediment to wider access to healthcare[6,7,9]. At the same time, remedying these systemic shortcomings or devising ways to extend health insurance as an alternative funding modality is contingent on effective targeting of resources, based on knowledge of healthcare needs and costs.

It is possible to find data on the cost of specific pathologies that were sampled in a specific place: for instance on expenditures incurred by diabetics in south India[10]; on ambulatory care of diabetes in north India[11]; on the costs of typhoid fever in Delhi[12]; and on epilepsy in six Indian States[13]. Information is also available on overall cost of specific illnesses at the level of States or in the entire country, *e.g.,* on tuberculosis, malaria and HIV/AIDS[14]; on HIV/AIDS[15]; on dental diseases[16]; on chronic asthma[17]; and on blindness[18] and on leprosy, malaria and TB[19]. However, most decisions regarding healthcare spending depend neither on national averages nor on a narrow list of pathologies, but on needs of individuals, and on costs and supply of healthcare relating to a wide range of acute or chronic illnesses or accidents, which are context-specific. And the rapid pace of change in the medical needs[20] or in socio-economic and demographic parameters[21] or in the cost of care[22] suggests that recent evidence is indispensable.

The purpose of this study was to collect recent data on the cost of illness in five resource-poor locations in India. The analysis published here offers an assessment of perceived needs for healthcare (as expressed by the reported morbidity), demand (as expressed by the OOPS due to illness episodes reported), and financial risks that illness presented among the sampled population. Having used data from different locations enabled us to identify similarities and differences across locations.

Material & Methods

Data sources:

Household survey data - We conducted a household (HH) survey in five locations in India (Table I). Prior to the full survey, the questionnaire was peer-reviewed in Germany[1] (We consulted The Centre for Survey Research and Methodology (ZUMA) in Mannheim in setting up, and conducting this study. *http://www.gesis.org/en/zuma/index.htm*) and cognitively tested in India. It included, *inter alia*, sections on HH demographics, education, income, expenditure and self-reported illness episodes in the HH within the three months prior to the interview. The data were obtained through field interventions from April to September 2005 under the project "Strengthening micro health insurance units for the poor in India". In view of the focus of that project, the survey was carried out in locations where micro health insurance units (MIUs) operate, and included both insured and uninsured respondents. The research question was "assessing the OOPS due to illness of the target population". Incidentally, none of the MIUs included in this study operated cashless reimbursement, and all covered only hospitalizations up to a low cap. As it would have been possible that insured cohorts would pay higher OOPS (*e.g.,* due to an expectation of reimbursement), we compared OOPS paid by insured and uninsured cohorts in all locations disregarding possible reimbursements

Table I. Locations where the household (HH) survey was conducted

Location	State	District	Villages/ communities included	Rural HH	Urban HH	Insured HH	Uninsured HH	Total HH per location
I	Maharashtra	Pune	34	708		349	359	708
II	Maharashtra	Pune	34		700	347	353	700
III	Bihar	Patna	8	160		80	80	
		Vaishali	8	160		80	80	
		Khagaria	9	180		89	91	
		Muzaffarpur	5		100	50	50	
		Nawada	2	40		20	20	
		Begusarai	3	60		30	30	700
IV	Tamil Nadu	Theni	34	722		360	362	722
V	Tamil Nadu	Chennai	33		701	350	351	701
Entire sample			170	2,030	1,501	1,755	1,776	3,531

Table II. Relative share of cost components (in INR)

Cost item	Mean ± SEM	% of total	Median
Direct	779 ± 34	67.2	200
Indirect	343 ± 16	29.6	50
Informal	37 ± 5	3.2	0
Total	1159 ± 44	100.0	340

All values are calculated on the total number of illness episodes (n=4,316)

due to affiliation with MIUs, to ensure that the comparison was between comparable situations. The comparison was made for direct, indirect, informal and total costs per illness episode. No significant difference in OOPS per illness episode was revealed across the two cohorts for any cost item examined. We also examined the effect of insurance status on OOPS for hospitalization per illness episode, and found no significant difference between insured and uninsured. Hence, we did not examine the impact of insurance status *per se*, and the data relating to both insured and uninsured cohorts were aggregated for each location, to enhance statistical robustness of the findings (aggregated data shown in Table II, separate values for insured and uninsured are not shown).

Sampling followed a cross-sectional design in a two-stage sampling method: in the first stage, we selected locations purposively, from among MIUs that agreed to participate, which were located in three States (Maharashtra, Bihar, and Tamil Nadu). In the second stage, several villages (or urban areas) within each location were randomly included, and at each village about 10 insured HH (selected according to the systematic circular sampling method), plus about 10 uninsured HH (selected by using the "Right Hand Rule" of field movement) were surveyed. We surveyed some 350 insured and 350 uninsured HH per location. The sampled population included 3,531 HH, representing a total of 17,323 individuals. The questionnaire referred to illness episodes that occurred during three months preceding the survey. A total of 2,204 HH (representing 10,984 persons) reported at least one illness episode, and some reported more than one; the total number of illness episodes was 4,316 (henceforth the entire sample).

Calculation of the average cost of illness episode per household - The sum of the cost of all illness episodes per HH was divided by the number of illness episodes. This calculation normalized all households reporting an illness episode to have the same statistical weight, regardless of the number of illness episodes reported by the household. HHs reporting no illness episode were not included. This variable is referred to henceforth as "cost of illness episode per household".

Calculation of the income per HH member - The total income of each household (including wages, own enterprise, income in kind) was divided by the number of persons in that same household. This measure of household income per member is used to compare economic status of households.

The validity of income data was checked against the expenditure data. The correlation between income per HH member and non health expenditure per HH member was significant ($P<0.0001$). The regression coefficient (when income was the dependent and expenditure the independent variable) was 1.18 ± 0.04 (mean ± SEM) with an intercept that was not different from zero. This means that income per person and expenditure per person were very close. As income was composed of fewer details than expenditure, we surmised that it might be less sensitive to recall bias.

Statistical analysis: The large differences between mean and median values of the various cost data indicated that the distribution of costs was quite skewed. Hence, we used the non parametric Median test to examine significance of difference when comparing the same variable in two or more sub-groups. This test is justified because we posit neither an assumption of identical distributions of the different sub-cohorts included in the sampled population, nor identical variances of the variables in the sub-groups.

The multivariate linear regression analysis is a parametric test that requires symmetrically distributed data. As the data did not satisfy this condition, we applied a log transformation. The skewness, which ranged from 7.27 to 9.1 with the raw data, was 0.02 to 0.35 after log transformation; and the kurtosis dropped from a range of 75 - 102 to a range of 2.88 - 3.25. The ratio of mean to median was lower than 1.01 for all items after log transformation. The transformed data were thus suitable for the regression analysis.

The statistical analysis was performed using Stata (v.9), SPSS (v.12), and Excel (v.2003).

Box-plot figures:

In Fig. 1, cost data are shown by modified box plots, where the extreme outliers are excluded, following the method proposed by Tukey[23]. Each box graph starts with quartile 1 and ends with quartile 3, and thus the boxes

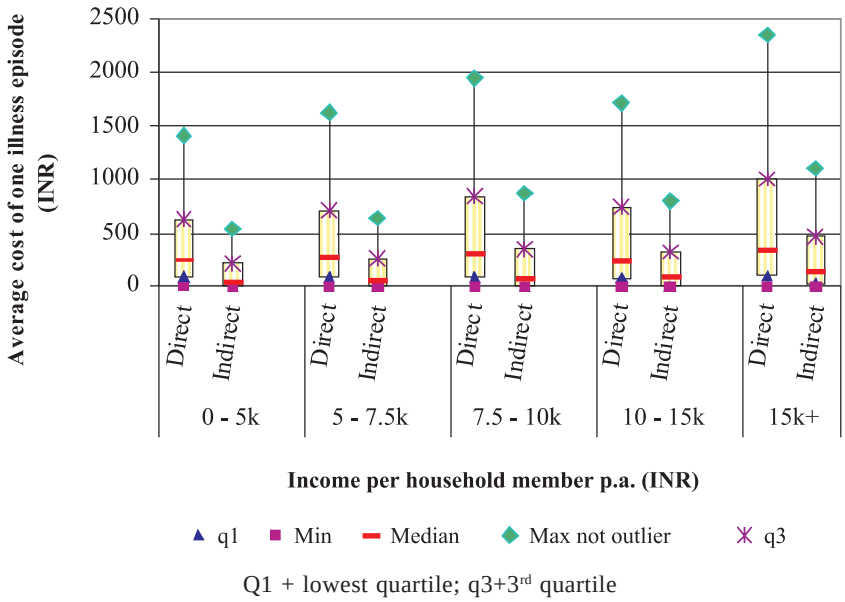

Fig. 1. Cost of illness episode per household (in INR, mean ± SEM).

contain the interquartile range of all data. The boxes contain lines (called "whiskers")[23]: the upper "whisker" indicates the cut-off point of the maximum value in the data set. The cumulative frequencies show that the excluded data points represent 5-12 per cent of all cost data.

Results

Cost of one illness episode

The household survey questionnaire included questions on three components of the cost of illness episodes: (*i*) direct formal costs (including allopathic consultations, prescribed allopathic drugs, tests and hospitalizations); (*ii*) informal costs (including traditional consultations and drugs, and OTC drugs); and (*iii*) indirect costs (including wage loss of the ill and of the care-giver, and transportation costs).

The median cost of one illness episode, including all three components, was INR 340 (Table II). Direct formal costs represented about two-thirds; indirect costs represented close to one third; and informal costs contributed only 3.2 per cent. Consequently, the analysis was based on total cost (including all three components) or on the first two components, as appropriate.

Classification of illness episodes by illness type

The HH survey included questions about reported illness episodes; respondents were asked to describe, in their own words, what kind of illness occurred (and answers were coded in 86 categories – listed in the Appendix, and whether the same illness occurred repeatedly to the same person. Respondents could describe an illness episode in more than one way. The replies were analyzed and sorted by one of the authors (OvP-R), a physician, into three types: acute illnesses, chronic illnesses, and accidents.

Of the 4,316 illness episodes, 63.6 per cent were classified as acute [The three most prevalent acute illnesses related to parasitic (fever, malaria) (54% of acute), respiratory tract infections (22%), and digestive disorders (13%)], 18.5 per cent were classified as chronic [Among the chronic diseases, the most frequently mentioned were cardiovascular (21% of chronic), musculoskeletal & connective tissue disorders (20%), asthma (9%) an diabetes mellitus (4%)], 3.6 per cent were classified as accidents [Most accidents (95%) involved wounds and fractures], and the remaining 14.3 per cent descriptions or symptoms which fitted more than one category were classified as "undetermined". Statistical analysis of illness data was carried out on the entire file (including the undetermined diseases as a separate category).

The distribution of the four illness types by age groups is shown in Fig. 2.

The difference in morbidity patterns across age groups was striking; among the young, acute illnesses accounted for about 85 per cent of total, but among the 55> yr these represented less than 30 per cent. On the other hand, chronic disorders represented only 6 per cent of illness episodes among children and adolescents,

Appendix. Self reported descriptions of illnesses
(classified into four illness types: acute, chronic, accidents and undefined)

Serial	Category	Serial	Category
1	Fever/Malaria	44	Measles
2	Bodyache/Body pain	45	Blood clots
3	Cold & cough	46	Electricity shock
4	Hand pain	47	Abortion
5	Joint pain	48	Cancer
6	Stomach pain	49	Paralysis attack
7	Asthma	50	Appendix
8	Gas problems	51	Astropolisys
9	Vomiting	52	Problem to speak from long period
10	Dysentery/loose motion	53	Tumour
11	Ear pain	54	Piles
12	Tonsils	55	Liver problem
13	Chest pain	56	Sciatica
14	Jaundice	57	Falaria
15	Wound	58	Synus
16	Food poisoning	59	Medicine reaction
17	Headache	60	Sun stroke
18	Backache	61	Peecolite
19	Blood pressure	62	Mental problem
20	Appendix operation	63	Water in lungs
21	Heart problem	64	Polio
22	Eye problem	65	Less appetite
23	Check-up	66	Hole in the stine
24	Loss of weight/Weakness	67	Meningitis
25	Diabetes/Sugar	68	Tetanus
26	Fracture	69	Hernia
27	Tuberculosis	70	Hydrophobia
28	Teethache	71	Fit/(seizures)
29	Swelling of hands/legs	72	Stone
30	Uterus problems/menses problems	73	Hives
31	Itching	74	Sprain in hand
32	Sexual disease	75	Knee pain
33	Smallpox	76	Injury on head
34	Leg pain	77	Pneumonia
35	Fainting/Head reels	78	Chicken pox
36	Heat	79	Rheumatism
37	Ulcer	80	Leg injury
38	Not born growth	81	Boils on body
39	Nosal bleeding	82	Sickness due to polluted water
40	Sore	83	Piles
41	Rabies	84	Brain surgery
42	Skin disease	85	Cramps
43	Dropsy	86	Menstrual pain

but more than 50 per cent of total illnesses among the elderly.

Average cost of benefit types by illness type

Our dataset provided information that components of care (hospital, consultation, drugs) represented very different shares for the three types of illness (acute, chronic and accidents) (Table III). In acute diseases the highest median costs were due to tests and drugs; in chronic illnesses, hospitalization and drugs were highest; and in accidents, hospitalization was the costliest item. Furthermore, mean and median costs were higher for all benefit types in chronic illness episodes compared to acute illness episodes.

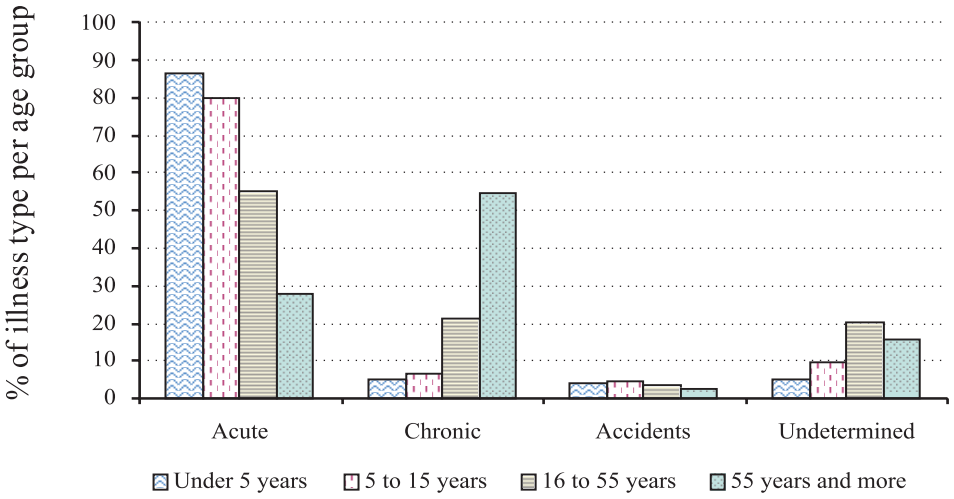

Fig. 2. Distribution of illness types by age-groups, as % of total illness.

Table III. Breakdown of costs per illness episode by type of healthcare and illness type

Illness	Acute			Chronic			Accidents			Significance*
Care	*n*	Median	Mean ± SEM	*n*	Median	Mean ± SEM	*n*	Median	Mean ± SEM	*P*<
Hospitalization	560	50	663 ± 84	233	300	1797 ± 304	50	425	1568 ± 338	0.001
Consultation	2450	50	124 ± 8	689	100	263 ± 23	139	50	327 ± 82	0.001
Drugs	2232	130	302 ± 12	675	300	672 ± 40	131	200	632 ± 100	0.001
Tests	378	150	246 ± 20	266	200	393 ± 38	40	205	574 ± 193	0.001
Significance of difference across types of care		*P*<0.001			*P*<0.001			*P*<0.001		

n denotes illness episodes in which the benefit type occurred at least once
* Significance of difference across illness types

An integrated view of the effect of age, gender & illness type on cost of illness

A multivariate linear regression was applied in order to examine the inter-relationship of the effect of age, gender and illness type on the cost of illness episodes. The outcome of the multivariate regression analysis using the logarithmically transformed costs data is shown in Table IV. Results for direct, indirect and total costs (which included also informal costs) are shown side-by-side.

This analysis provided evidence that the total cost of illness associated with females was significantly lower than the cost associated with males (β= -0.066), and the same held true for indirect costs of illness (β= -0.119), but not for the direct costs of illness, where no significant gender difference was found (Table IV).

Considering that indirect costs include wage loss, one might wonder whether the higher indirect costs associated with males could be linked to income-loss among economically active persons. However, this gender bias was persistent in all age groups (data not shown), suggesting that the explanation of a link to economic activity was at least inconclusive. It was interesting to note that this dataset did not reveal any difference in the direct cost of healthcare between the genders.

The cost of chronic illnesses and accidents was higher than the cost of acute illnesses in direct, indirect and total cost categories, and the differences are statistically significant β= 0.244 for chronic illnesses, and 0.098 for accidents with acute illnesses as the reference (Table IV). Taking the age group of 5 to 15 as reference, the direct costs of illness were higher among those aged <5 and >55. As for indirect costs, these were lower among the persons aged <5 but higher among the economically active aged 16 to 55 yr.

Table IV. Results of the multivariate regression of the cost per illness episode (log transformed)

	Direct			Indirect			Total		
	Regression coefficient (B) ± SE	*P* (t test)	β (adjusted coefficient)	Regression coefficient (B) ± SE	*P* (t test)	β (adjusted coefficient)	Regression coefficient (B) ± SE	*P* (t test)	β (adjusted coefficient)
Gender:									
Male	Ref.								
Female	-0.028 ± 0.043	NS	-0.01	-0.346 ± 0.051	<0.001	-0.119	-0.198 ± 0.044	<0.001	-0.066
Age groups (yr):									
<5	0.158 ± 0.066	0.017	0.043	-0.182 ± 0.084	0.03	-0.047	0.121 ± 0.068	0.075	0.031
5 to 15	Ref.								
16 to 55	0.06 ± 0.056	NS	0.021	0.491 ± 0.069	<0.001	0.169	0.203 ± 0.057	<0.001	0.067
55>	0.159 ± 0.087	0.068	0.034	0.100 ± 0.104	NS	0.021	0.079 ± 0.088	NS	0.016
Illness type:									
Acute	Ref.								
Chronic	0.887 ± 0.061	<0.001	0.244	0.420 ± 0.069	<0.001	0.119	0.869 ± 0.062	<0.001	0.225
Accident	0.746 ± 0.116	<0.001	0.098	0.672 ± 0.135	<0.001	0.088	0.835 ± 0.118	<0.001	0.102
Undetermined	0.317 ± 0.067	<0.001	0.074	0.394 ± 0.074	<0.001	0.098	0.274 ± 0.065	<0.001	0.063
Benefit type:									
Not hospitalized	Ref.								
Hospitalized	1.047 ± 0.051	<0.001	0.311	0.829 ± 0.060	<0.001	0.244	1.099 ± 0.052	<0.001	0.301
Constant	5.160 ± 0.05	<0.001		4.665 ± 0.063	<0.001		5.446 ± 0.051	<0.001	
n	3677*			2802*			4117*		
r-squared	0.1776			0.1516			0.1674		

*The n values used here (number of illness episodes) were lower than the overall reported number of illness episodes, because all illness episodes in which a cost component was equal to zero had to be excluded in this analysis of logarithmically transformed data.
NS, not significant

A comparison of the adjusted regression coefficients revealed a high impact of being hospitalized on the cost of an illness episode (β= 0.311 for direct costs and β=0.244 for indirect costs). One way of accounting for this finding was to look at the costs of other benefit types (*e.g.*, tests and drugs) in illness episodes requiring hospitalizations. We assumed that people with serious conditions required more tests, drugs and consultations, in addition to hospitalization. This assumption was indeed borne out by the data, as shown in Table V.

Effect of household attributes on the cost of illness

The analysis has so far focused on cost of illness as predicated by the attributes of the individual patient and illness type. However, we assumed that socio-economic parameters of the household in which the illness occurs could also influence the cost of illness. Therefore, the subsequent analysis dealt with the cost of illness as predicated by household attributes. The parameter used was the "cost of illness episode per household", which was useful here because it assured the same statistical weight for each household that reported an illness, regardless of the number of illness episodes in the household.

Effect of income on the cost of illness episodes

The HH survey included questions on household income (from all sources, both cash and kind), which made it possible to examine the association between HH income (normalized per HH member) and the cost of illness episode per household. From the data presented in Fig. 1 it was apparent that both the direct and indirect cost of illness increased with household income. However, this increase was most apparent at the highest income group. The difference across the income groups, which were of very similar size, was significant (direct costs $P<0.05$ and indirect costs $P<0.0001$, by Median test).

Differences in costs and provider type across locations

The difference across locations in the cost of illness per household is shown in Table VI.

With the view to understanding the underlying reasons for the considerable differences across locations, those costs are now broken down by the main benefit types. These data, shown in Table VII, confirmed significant differences in the cost of each of the benefit types across the locations. The differences across locations in median values of consultations, tests

Table V. Association between hospitalization and other benefit types

Cost of benefit type (in INR)	With hospitalization		Without hospitalization		Significance of difference (Median test)$P<$
	Mean ± SEM	Median	Mean ± SEM	Median	
Consultations	295 ± 30	40	115 ± 6	50	0.160
Prescribed drugs	566 ± 34	150	259 ± 9	100	0.000
Tests	189 ± 19	0	30 ± 2	0	0.000
Indirect costs	772 ± 57	120.5	220 ± 11	50	0.000

n = 960 (with hospitalizations) and 3,356 (without hospitalizations); all episodes were included in the calculations, notably those in which the cost for the other benefits = 0

Table VI. The effect of location on the average cost of illness episode per household

Location	n	Direct (in INR)		Indirect (in INR)	
		Median	Mean ± SEM	Median	Mean ± SEM
I	314	402	1760 ± 267.7	132	540 ± 81.9
II	318	153	975 ± 148.2	0	301 ± 58.6
III	524	450	851 ± 61.4	50	199 ± 22.3
IV	621	130	544 ± 51.7	150	476 ± 38.4
V	427	230	832 ± 92.1	50	471 ± 59.4
Entire sample	2204	264*	908 ± 52.1	76	393 ± 22.2

n, signifies here the number of households that reported at least one illness episode

*The median value is well within the range of the average medical expenditure for a non-hospitalized ailing person for rural respondents (240 to 275) published by the National Sample Survey (60th round)[24]. We compared the median, as it is not affected by catastrophic costs, usually related to hospitalizations.

Table VII. Comparison of the cost of benefit types per illness episode across locations (in INR)

	Consultations				Hospitalizations				Drugs*				Tests			
Location	Median	Mean	SEM	n	Median	Mean	SEM	n	Median	Mean	SEM	n	Median	Mean	SEM	n
I	100	307	34	459	2000	3871	716	90	200	436	40	419	250	590	90	129
II	60	180	19	425	1000	2541	506	63	100	371	41	360	250	410	49	82
III	60	117	12	1108	463	1398	221	122	300	547	24	1120	200	298	24	230
IV	46	201	20	1255	75	979	205	120	100	290	21	1061	80	287	59	195
V	30	126	14	550	40	366	55	565	100	313	27	557	120	264	31	178
Entire sample	50	176	9	3797	100	1045**	96	960	150	401	13	3517	180	345	23	814
Significance		$P<0.001$				$P<0.001$				$P<0.001$				$P<0.001$		

n, signifies here the number of illness episodes in which this benefit was used at least once

*The question specifically referred to prescribed allopathic drugs procured in a pharmacy (*i.e.*, neither drugs provided by the consulting physician nor traditional medicines); **We obtained a lower estimate than the NSS (60^{th} round)[24] for rural persons, which was 5695). Difference can be explained by two reasons: (*i*) the NSS considered all costs during hospitalizations, whereas Our survey referred to accommodation and treatment but excluding additional charges for drugs and tests: (*ii*) our population was exclusively composed of poor persons, whereas the NSS has taken into account all income levels in rural areas.

Table VIII. Difference in cost of benefit type by provider type

Provider	Private			Public			Charitable			Significance
Benefits	Median	Mean ± SEM	*n*	Median	Mean ± SEM	*n*	Median	Mean ± SEM	*n*	(Median test)
Hospitalization+	300	1405 ± 151	522	40	746 ± 147	279	30	386 ± 149	146	$P<0.001$
Consultations	60	155 ± 10	2737	30	138 ± 17	721	20	94 ± 16	198	$P<0.001$
Drugs	180	409 ± 13	3323	20	231 ± 69	110	15	282 ± 73	80	$P<0.001$

n, signifies here the number of illness episodes in which this benefit was used at least once

+The NSS (60^{th} round)[24] estimated the all India cost per hospitalization (including all costs) in private hospitals (7408) and in government hospitals (3238). Our estimate was again lower; the same possible explanations for the lower estimate that were stated in the previous footnote are valid here as well.

and drugs were in the order of three-fold, and in the order of 50-fold in hospitalizations; and when mean values were compared, the differences were in the order of 2-fold for drugs and tests, 3-fold for consultations, and 11-fold for hospitalizations.

A possible explanation for this large spread could be the different cost applied by private, public or charitable providers of healthcare. This possible explanation was verified by inclusion in the HH survey of the following question: "is the facility you normally use a private, public or charitable provider?" The replies, shown in Table VIII, confirmed that private providers charged much higher prices than public and charitable providers for hospitalization; and pubic providers charged higher prices than charitable providers for hospitalizations and consultations, but not for drugs.

The strength of this explanation was contingent on the frequency of choice of provider types in different locations. As can be seen in Table IX, the lower cost of hospitalizations in locations IV and V could be due to the higher frequency of access to public and charitable facilities. But the different cost in locations I, II and III could not be attributed to this variable, in view of the fact that the majority of households (upward of 80% of HH) used private hospitals in those three locations. The difference in the cost of drugs could not be linked to provider type, as more than 88 per cent of households accessed private pharmacies in all locations. And also for the cost of consultations, there was no clear association with provider type.

Relative share of different benefit types

It is self-explanatory that the financial burden of seeking healthcare was a function not only of the cost of a certain benefit type but also of the likelihood it will be used in case of illness.

For each household that reported at least one illness episode the relative share of the cost of the various benefit types was calculated. The results shown in Fig. 3 are averaged across all relevant households. It emerged clearly that hospitalization costs represented a low share of total aggregated costs in all locations. The same was true for tests. The share of drugs was the largest component in the entire sample and in three of the five locations. And the share of cost of consultations was the largest component in the remaining two locations.

Financial consequences of the cost of illness

In order to understand the consequences of an illness episode on the finances of the sampled households, we calculated a new variable: the cost of an illness episode in the household divided by income per household member. This variable was obtained by dividing the average total cost of an illness episode per household (including direct, informal and indirect costs) by the monthly income per household member in the same household. A ratio of 1 would mean that the cost of one illness episode was equivalent to the monthly income of one person in the same household.

The median value of this ratio was calculated separately for each location, and for the entire sample,

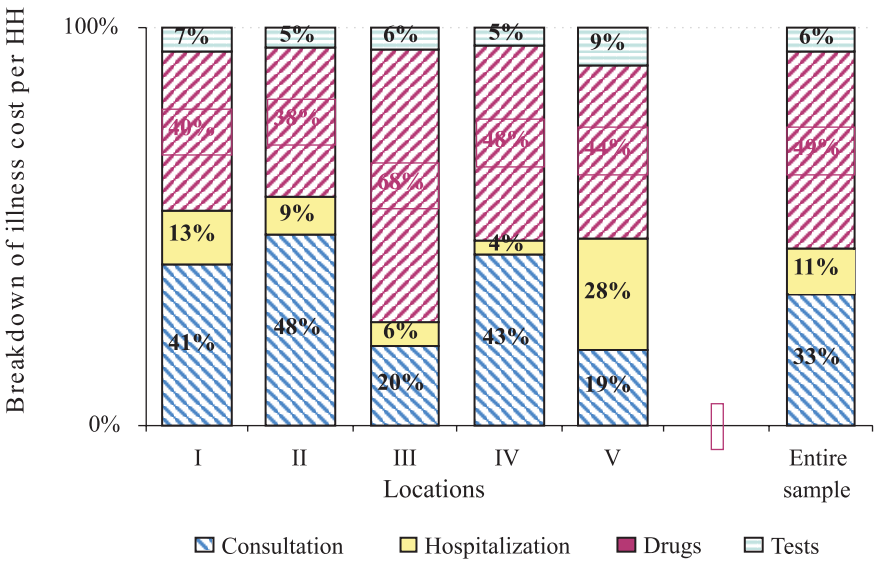

Fig. 3. Breakdown of the cost of illness by benefit types and by locations (% cost per household).

Table IX. Frequency of access (%) to benefits by provider type

Benefit	Consultations			Hospitalizations			Drugs		
Location	Private	Public	Charitable	Private	Public	Charitable	Private	Public	Charitable
I	92.3	3.2	4.5	84.9	10.6	4.5	96.8	0.6	2.6
II	97.8	1.9	0.3	88.5	10.5	1.0	99.1	0.9	0.0
III	96.3	3.7	0.0	84.1	15.7	0.2	98.3	1.5	0.2
IV	52.1	46.8	1.1	43.7	55.9	0.4	90.6	9.1	0.3
V	60.8	12.4	26.8	40.6	36.1	23.3	88.3	1.6	10.1

Table X. Ratio between cost of illness per household and monthly income per household member

Location	Median cost (INR) per illness episode	Median income (INR) per HH member	Median ratio of cost/income ratio
I	668	800	1.00
II	214	750	0.38
III	590	583	1.07
IV	380	878	0.41
V	400	500	1.2
Entire sample	445	692	0.73

(Note: The median of this ratio is obviously different from the ratio of the median cost divided by the median income for the cohort of each location)

and the data presented in Table X. The ratio ranged from 0.38 to 1.2, signifying that for half the population in each location, the cost of one illness episode ranged from 38 to 120 per cent of monthly income per person. As in previous observations, the differences across locations were considerable also in respect of this measure of financial exposure. This difference in the ratios originated from the combined effect of different levels of costs of healthcare services and different income levels. For instance, the higher ratio in location I compared to location II was mainly due to the different cost of healthcare, whereas income levels were quite similar. On the other hand, the higher ratio in location V compared to IV was associated mainly with lower income in V.

The median ratio for the entire sample was 0.73, signifying that half the population spent an amount equivalent to at least 73 per cent of the monthly per capita income for one illness episode (Table X). However, half the households with income up to INR 5,000 per year (the poorest quintile) spent 308 per cent of monthly per capita income or more on an episode, whereas half the households with annual income above INR 15,000 (the wealthiest quintile) spent only 31 per cent of monthly per capita income or more for a comparable event. And the 10 per cent most exposed households in the sampled population (*i.e.*, the 10% of HH that had the highest ratio) had to pay 780 per cent of monthly income per person for a single illness (detailed data not shown).

The ratio has also been calculated for the direct costs only; the median value of this ratio was 0.45, and it ranged between 2.0 for the lowest income quintile and 0.15 for the highest quintile.

Illness episodes involving hospitalizations were costlier, both because of the contribution of the cost of hospital *per se* and because of the higher cost of other components (such as tests, drugs, *etc*.). What then is the impact of hospitalizations on financial exposure of the sampled population? The median of the ratio between cost of an illness episode involving hospitalization and monthly income of one HH member was 2.79 (meaning that 50% of the households that experienced a hospitalization paid an amount equal to 2.79 monthly income per HH member) or 1.92 (when only direct costs were counted), compared to 0.53 and 0.30 respectively for households that did not experience hospitalization.

Limitations of the data

This study was based on survey data in five locations, which comport two limitations: (*i*) the data originated from five locations in three States, and when

we consider the large differences across locations we must emit a reserve that the numbers we obtained (or calculated) cannot be construed to be valid for all of India. We have shown trends that offer insights for multiple locations, and the parameters that influence the cost of illness. Therefore, the order of magnitude of the cost of an illness may serve as an indicator for other resource-poor locations in India; (*ii*) the source data comprise self-reported information on cost of care per illness episodes during three months preceding the survey. The limitations of self-reported data must be recognized upfront: there was no local external or objective record of costs or illnesses against which the results could be validated; the classification of illness types was based on a physician's interpretation of self-reported descriptions of diagnoses and symptoms, rather than on official medical records; and recall bias could cause incomplete recording of the number and cost of tests, prescriptions and consultations.

Discussion

There is relatively little evidence on the cost of illness among resource-poor persons. While one, frequently cited, source suggests that every fourth hospitalized Indian falls below the poverty line[2] there is very little literature on the cost of other components of healthcare, and on the financial exposure related to them. The aim of this study was therefore to make a contribution by providing information on the cost of illness episodes among resource-poor persons in five locations in India.

We found that informal costs accounted for only 3.2 per cent of total. This low share seems to tally with other reports on the low utilization of indigenous systems of medicine in India[25,26].

As for the comparison between direct and indirect costs, our results for all types of illness and the entire sampled population suggested that about two-thirds of total healthcare expenses were due to direct costs and less than one third were due to indirect costs. Our analysis of cost data was based on the assumption that the cost of an illness episode was influenced by (*i*) the individual features of the patient and the pathology; (*ii*) the location in which the family resides.

Among the individual features, the first observation was the significantly lower level of total cost of illness among females, attributable only to indirect costs. As this difference was significant in all age groups, it was perhaps due to decisions taken by households on allocating resources for illness-related travel and care-giving of males vs. females.

The second observation was that age differences had a major effect on direct, indirect and total costs of illness. While the population under 16 yr of age represented 40.4 per cent of illness episodes, it accounted for only 24.3 per cent of total costs of illness. The large gap in cost by age can be illustrated by the ratio of relative cost to relative incidence for the different age groups. "Relative costs" is the share of costs associated with the specific age group relative to the total cost of care; and "relative incidence" is the share of illness episodes associated with the specific age group relative to the total number of illness episodes. This ratio was 0.7 for the under 5 age group and 0.6 for persons aged 6-15, then rose sharply to 1.2 among the 16-55 yr age group and to 1.3 among persons aged >55.

The most immediate explanation for this difference could be the morbidity afflicting the two age groups. Whereas the young were more exposed to acute illnesses, the adults were more prone to chronic diseases; and the costs associated with these illness types were markedly different. Hence, the acute illnesses, representing 61 per cent of total illnesses, accounted for only 37.4 per cent of total costs, but chronic illnesses, representing only 17.7 per cent of illnesses accounted for 32 per cent of the costs.

The higher cost of chronic illnesses recorded in this study needs to be seen in the context of a growing prevalence in India of diabetes mellitus[27,28], hypertension[29], cardiovascular diseases[30,31], and other chronic conditions[20,32]. Shetty[33] claimed that there is clear evidence of a demographic, epidemiological and nutritional transition in India that is fuelling the increase of chronic diseases and obesity, particularly in urban areas. Thus projections of increased prevalence of chronic diseases foretell an increase in the cost of illness due to higher cost of chronic diseases shown in this study, and due to an expected increase in the number of years that subjects will suffer from chronic morbidity and disability[34].

Bearing in mind that direct costs accounted for about two-thirds of the total cost of illnesses, we looked at the data in two complementary ways: (*i*) the cost of benefits only when utilized; and (*ii*) the aggregated contribution of a benefit type to the overall cost, which takes into account frequency of use.

Hospitalization is usually considered as the prime source of catastrophic financial exposure[2]. Our data confirmed that when hospitalization was required it was indeed the most costly component on average, and this was true in all three morbidity types (acute, chronic or accident). Yet we also observed that severe illnesses that required hospitalizations were also associated with higher costs for other benefit types (*e.g.*, tests, drugs, *etc*.). This combined effect could explain the high impact of hospitalization on the cost of illness that can be seen in the multivariate linear regression model.

Drugs were the second most expensive item in all types of morbidity. In fact, drugs were used much more frequently than hospitalizations. Therefore, it was not surprising that on an aggregated basis, drugs accounted for 49 per cent of total costs whereas hospitalizations accounted for only 11 per cent of total. One could of course raise the question whether the high cost of drugs is an unavoidable necessity? For one, the procurement price of drugs in public pharmacies is lower than in private pharmacies, but often the essential drugs are unavailable[22,35]. For instance, Madden & Kotwani[36] gathered information in Rajasthan on 36 drugs, 27 of which are in the WHO 'core medicine list', and they found that most of the medicines were found in most private pharmacies and availability of generics was much higher in the private pharmacies, in contrast to public pharmacies where at least seven drugs were not found in any outlet. In a more comprehensive report, Kotwani *et al*[22] showed that prices in private pharmacies were higher than international reference prices, in the order of 1.5 to 4-times the comparable international prices. The scope for reducing overall costs could thus depend on reducing the markup on drugs, as well as on developing better protocols for the rational use of medicines (this last point has been the subject of some scrutiny in the literature[37-39]).

An interesting observation was that the cost associated with an illness episode increased as income increased. This could be expected in relation to indirect costs (which include "wage loss" and "resources devoted to caring for patients"). However, the increase in direct costs was not self explanatory; this increase could suggest costlier healthcare charged by more reputed providers, as well as higher compliance with costly treatment that richer HHs were able to bear. This finding is in line with information contained in the NSS[24] that upward of one quarter of untreated ailments is explained by lack of financial resources in rural India.

The difference in the cost of illness across locations was striking and was valid both in terms of absolute costs and in terms of relative shares of cost items. As already pointed out, income is not the main or only explanatory variable for this variation.

The supply of healthcare seemed to be a major explanatory variable in the difference of direct costs of healthcare across locations. Where public providers were used the cost was lower. However, this does not explain the full amplitude of cost differences by location. For instance, the costs reported in location II were much lower than in location I even though both are situated in the same district and where private providers are used often.

Having looked at the cost of a single illness episode, we assessed the overall per capita cost due to illness, considering the frequency of illnesses. For this purpose, we used the number of illness episodes (4,316), the number of months during which they occurred (3), the number of persons in the sample (17,323), and the median ratio of financial exposure, with which we obtained the estimated median value of the reported out-of-pocket payment cum income loss due to an illness. Taken together, we concluded that the median per-capita cost of illness was 6 per cent of annual per-capita income[4]. This per cent was normalized to take account of the differences in family size and location.

The estimate of the financial burden was calculated a second time, by reference to direct cost of healthcare only. The level of financial exposure under this calculation was 3.7 per cent. Two recent publications on the level of out-of-pocket payment for healthcare as percentage of total household resources (counting only direct costs) for all of India put this burden at 2.17 per cent[6,7]. Our calculation was remarkably close to that of van Doorslaer *et al*[7] when results were adjusted to account for the lower median income of the populations in our sample. According to van Doorslaer *et al*[7], 31 per cent of the population had an income below $1.08 per day, while in our survey, 50 per cent of the population had an income of up to US$ 0.52 per day.

Finally, our results confirmed that half the hospitalized respondents spent more than 23 per cent of their annual income for healthcare. This expenditure included both direct and indirect costs (not only the cost of hospitalizations). We have also calculated the mean cost of healthcare borne by persons with a hospitalization, and found it to be 60.6 per cent of annual income. This reflects the influence of outlier cases, and

indeed the top ten per cent of spenders spent on an average 150 per cent of their annual income on a single illness episode involving hospitalization.

We conclude that the cost per illness episode will inevitably increase in the next decade in India. This conclusion is based on the observation that the chronic illnesses, prevalent mainly among the adults and elderly, were much costlier, coupled with demographic projections on changes in age composition[40] and an increase in life expectancy[41].

Our study showed that the main financial burden of illness among the surveyed poor population was due to the combined cost of drugs and primary care, more so than due to the cost of hospitalizations. However, when they occur, hospitalizations can have a devastating financial impact.

Locations differed from each other in the absolute cost of care, in the relative share of types of care composing the total cost of illness, and in the availability of supply. Therefore, developing a model for the delivery of affordable healthcare coverage for resource-poor persons cannot rely solely on macroeconomic cost information but must take account of the pronounced differences in cost of illnesses across different locations in India.

Acknowledgment

This household survey was organized as part of the project "Strengthening Micro Health Insurance Units for the Poor in India" started in 2005-2006. This project was jointly implemented by the Institute of Health Policy and Management at Erasmus University Rotterdam (Netherlands), the Federation of Indian Chambers of Commerce and Industry-FICCI (India) and the University of Cologne (Germany) with funding from the European Commission through the EU-India Economic Cross Cultural Programme (ECCP). Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) provided additional funding to enlarge sample size of the household survey. Logistical support was provided by the Birla Institute for Management Technology, Greater Noida (India). Shri Ralf Radermacher (University of Cologne), ECCP project co-ordinator, provided support all along the process. We thank Dr Trea Laske-Aldershof, Erasmus University Rotterdam/MC for statistical advice and Ms. Erika Binnendijk, Erasmus University, Rotterdam for support in referencing.

References

1. Bhat R. Characteristics of private medical practice in India: a provider perspective. *Health Policy Plan* 1999; *14* : 26-37.
2. Peters DH, Yazbeck AS, Sharma RP, Ramana GNV, Pritchett LH, Wagstaff A. *Better health systems for India's poor: Findings, analysis and options*. Washington (DC): World Bank; 2002. p. 4-14.
3. Radwan I. *India: private health services for the poor, a policy note*. Washington (DC): World Bank; 2005. p. 12-8.
4. Bhat R, Babu SK. Health insurance and third party administrators: Issues and challenges. *Econ Political Wkly* 2004; *39* : 3149-59.
5. WHO. The World Health Report 2006: Working together for health. Geneva: World Health Organization; 2006. Annex Table 2. Available at *http://www.who.int/whr/2006/annex/06_annex2_en.pdf*, accessed on 26 March 2008.
6. van Doorslaer E, O'Donnell O, Rannan-Eliya RP, Somanathan A, Adhikari SR, Garg CC, *et al*. Paying out-of-pocket for health care in Asia: Catastrophic and poverty impact. *Working Paper No 2*: EQUITAP Project; Erasmus University, Rotterdam and IPS, Colombo. 2005. Available at *http://www.equitap.org/publication/wps/EquitapWP2.pdf*, accessed on 26 March 2008.
7. van Doorslaer E, O'Donnell O, Rannan-Eliya RP, Somanathan A, Adhikari SR, Garg CC, *et al*. Effect of payments for health care on poverty estimates in 11 countries in Asia: an analysis of household survey data. *Lancet* 2006; *368* : 1357-64.
8. Roy K, Howard DH. Equity in out-of-pocket payments for hospital care: Evidence from India. *Health Policy* 2007; *80* : 297-307.
9. James CD, Hanson K, McPake B, Balabanova D, Gwatkin D, Hopwood I, *et al*. To retain or remove user fees?: reflections on the current debate in low- and middle-income countries. *Appl Health Econ Health Policy* 2006; *5* : 137-53.
10. Shobhana R, Rama Rao P, Lavanya A, Williams R, Vijay V, Ramachandran A. Expenditure on health care incurred by diabetic subjects in a developing country - a study from southern India. *Diabetes Res Clin Pract* 2000; *48* : 37-42.
11. Grover S, Avasthi A, Bhansali A, Chakrabarti S, Kulhara P. Cost of ambulatory care of diabetes mellitus: a study from north India. *Postgrad Med J* 2005; *81* : 391-5.
12. Bahl R, Sinha A, Poulos C, Whittington D, Sazawal S, Kumar R, *et al*. Costs of illness due to typhoid fever in an Indian urban slum community: implications for vaccination policy. *J Health Popul Nutr* 2004; *22* : 304-10.
13. Thomas SV, Sarma PS, Alexander M, Pandit L, Shekhar L, Trivedi C, *et al*. Economic burden of epilepsy in India. *Epilepsia* 2001; *42* : 1052-60.
14. Russell S. The economic burden of illness for households in developing countries: a review of studies focusing on malaria, tuberculosis, and human immunodeficiency virus/acquired immunodeficiency syndrome. *Am J Trop Med Hyg* 2004; *71* (Suppl 2) : 147-55.
15. Mahal A, Rao B. HIV/AIDS epidemic in India: an economic perspective. *Indian J Med Res* 2005; *121* : 582-600.
16. Shah N. Oral and dental diseases: Causes, prevention and treatment strategies. *National Commission on Macroeconomics and Health Background Papers - Burden of Disease in India*. New Delhi: Ministry of Health & Family Welfare; 2005. p. 275-98.
17. Murthy KJR, Sastry JG. Economic burden of asthma. *National Commission on Macroeconimics and Health Background Papers - Burden of Disease in India*. New Delhi: Ministry of Health & Family Welfare; 2005. p. 251-63.

18. Dua AS. National programme for control of blindness. *National Commission on Macroeconomics and Health Background Papers - Burden of Disease in India*. New Delhi: Ministry of Health & Family Welfare; 2005. p. 299-304.
19. Dua AS. Programmes for the control of leprosy, tuberculosis and malaria. *National Commission on Macroeconomics and Health Background Papers - Burden of Disease in India.* New Delhi: Ministry of Health & Family Welfare; 2005. p. 9-23.
20. Srinath Reddy K, Shah B, Varghese C, Ramadoss A. Responding to the threat of chronic diseases in India. *Lancet* 2005; *366* : 1744-9.
21. Suhrcke M, Nugent RA, Stuckler D, Rocco L. *Chronic disease: An economic perspective*. London: Oxford Health Alliance; 2006. p. 11-28.
22. Kotwani A, Ewen M, Dey D, Iyer S, Lakshmi PK, Patel A, *et al*. Prices & availability of common medicines at six sites in India using a standard methodology. *Indian J Med Res* 2007; *125* : 645-54.
23. Tukey JW. Exploratory data analysis. London: Reading, Mass.: Addison-Wesley; 1977. In: *StataCorp*. *Stata Statistical Software: Manual Release 9*. College Station, TX: StataCorp LP; 2005. Section: Graph box-box plots.
24. Government of India I. Morbidity, health care and the condition of the aged. NSS 60th Round, Report No 507. New Delhi: National Sample Survey Organisation, Ministry of Statistics and Programme Implementation; 2005.
25. Gupta I, Dasgupta P. Demand for curative health care in rural India: Choosing between private, public and no care. Discussion papers series No 14/2000. Delhi: Institute of Economic Growth; 2000.
26. Singh P, Yadav RJ, Pandey A. Utilization of indigenous systems of medicine & homoeopathy in India. *Indian J Med Res* 2005; *122* : 137-42.
27. Deshpande SG, Tiwari R. Self medication - a growing concern. *Indian J Med Sci* 1997; *51* : 93-6.
28. Mohan V. Why are Indians more prone to diabetes? *J Assoc Physicians India* 2004; *52* : 468-74.
29. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertens* 2004; *18* : 73-8.
30. Goyal A, Yusuf S. The burden of cardiovascular disease in the Indian subcontinent. *Indian J Med Res* 2006; *124* : 235-44.
31. Callow AD. Cardiovascular disease 2005 - the global picture. *Vascul Pharmacol* 2006; *45* : 302-7.
32. Paramesh H. Epidemiology of asthma in India. *Indian J Pediatr* 2002; *69* : 309-12.
33. Shetty PS. Nutrition transition in India. *Public Health Nutr* 2002; *5* : 175-82.
34. Visscher TL, Seidell JC. The public health impact of obesity. *Annu Rev Public Health* 2001; *22* : 355-75.
35. Kotwani A, Gurbani N, Sharma S, Chaudhury RR. *Medicine Prices in the state of Rajasthan, India - Report of a survey of medicine prices, availability, affordability and price components in Rajasthan, India*. Delhi: Delhi Society for Promotion of Rational Use of Drugs; 2003.
36. Madden J, Kotwani A. Availability of essential medicines: An example from Rajasthan, India. Essential Drugs Monitor 2003; Issue 33 : 17. Available at *http://mednet2.who.int/edmonitor/33/EDM33_17_Availability-e.pdf*, accessed on March 26, 2008.
37. Das AK, Roy K, Kundu KK, Das N, Islam CN, Ram AK, *et al*. Study of rational utilisation and cost analysis of antimicrobials in a government teaching hospital. *Indian J Pharmacol* 2002; *34* : 59-61.
38. Patel V, Vaidya R, Naik D, Borker P. Irrational drug use in India: a prescription survey from Goa. *J Postgrad Med* 2005; *51* : 9-12.
39. Das B, Sarkar C, Majumder AG. Medication use for pediatric upper respiratory tract infections. *Fundam Clin Pharmacol* 2006; *20* : 385-90.
40. Government of India I. National Commission on Population - National Population Policy. 2000. Available from: *http://populationcommission.nic.in/npp_app3.htm*, accessed on August 6, 2007.
41. UN Database. Available from: *http://www.unsystem.org/SCN/archives/india/ch06.htm#b4-Life%20expectancy*, accessed on August 6, 2007.

Reprint requests: Dr David M. Dror Honorary Professor of Health Insurance, Institute for Health Policy & Management
Erasmus University Rotterdam/MC, Netherlands; & Chairman, the Micro Insurance Academy
D-127, Panchsheel Enclave, New Delhi 110 017, India
e-mail: daviddror@socialre.org , d.dror@erasmusmc.nl