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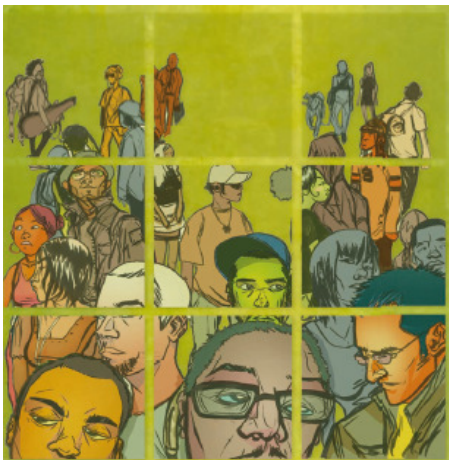
World Health Report (2010)
Background Paper, 52

HEALTH SYSTEMS FINANCING
The path to universal coverage

World Health Organization



Inefficiencies due to poor access to and irrational use of medicines to treat acute respiratory tract infections in children

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Introduction

Inappropriate (irrational) use of medicines is a significant source of inefficiencies in the finance of health systems. Desired treatment outcomes are not achieved when medicines are over-used, under-used or when applied inappropriately according to scientific guidelines. When medicines are over-used, they attract costs above the required to achieve the desired treatment outcomes. In addition, there are costs incurred with treating dose-related side effects which are likely to increase with overuse. Similarly, when medicines are generally consumed below the appropriate dose, desired treatment outcomes are less likely to be achieved. Treatment failures may lead to repeated or prolonged treatment episodes. Anti microbial resistance a likely sequelae of rampant inappropriate use of antibiotics also drives up treatment cost

Although there are treatment guidelines to inform prescribers on cost-effective use of medicines, a number of factors may affect their use particularly in low and middle-income countries. High prevalence of self-medication in these countries also contributes to the irrational, inappropriate and cost-ineffective (inefficient) use of medicines.

Health systems risk escalating costs of treatment when medicine use are not optimal, and are not prescribed cost-effectively especially if the diseases for which medicines are inappropriately used are prevalent such as: malaria, diarrhoea and acute respiratory infections.

Notwithstanding that inappropriate and irrational use of medicines could lead to inefficiencies in the delivery of care and may contribute significantly to health systems inefficiencies, explorations to estimates the cost-inefficiencies from inappropriate and irrational use of medicines are scarce in the published literature. The magnitude of the contribution of inappropriate (irrational) use of medicines to inefficiencies of health systems could be much higher in regions where medicines are the mainstay of care and interventions. For instance, medicines are the major intervention for chronic and infectious diseases which are prevalent in low-and middle income countries. In some of

these countries, the use of medicines which have no therapeutic value are common place. For instance majority of the childhood acute respiratory infection (ARI) of the upper respiratory tract would not require antibiotics, yet indications are that antibiotics are habitually used to treat ARI in many developing countries. An exploration of the overall inefficiencies attributable to irrational or inappropriate use of medicines in countries' health systems will require huge resources. Besides, data is currently not readily available to estimate this scope of system inefficiencies in countries. However, estimations for limited disease scope focusing for instance on ARI can provide insight on the extent of cost-inefficiencies in the regions.

This exploration is therefore intended to provide evidence of cost-inefficiency due to irrational use of medicines and poor access to appropriate treatment in countries using the example of the treatment of acute respiratory tract infections in the under 5-year olds as an indicator disease. It is assumed that deviations from treatment guidelines result in economic (or production) inefficiency in the production of care for ARI. By economic inefficiency it is implied that there is room to achieve the same level of care with yet lower costs, or achieve more care for given cost. In both situations, the "treatment production" level is below the production possibility frontiers. The magnitude of this deviation of the current treatment of ARI from the frontiers (what is achievable given appropriate use of medicines) is what is estimated in percentage form.

Methods

The assumption is that irrational, ineffective treatment for these childhood diseases will ultimately increase cost of treatment by: prolonging morbidity and extending exposure to greater treatment costs; deepening the severity of episodes and increasing the risk of complications; and increasing morbidity risks. Cost of treatment will increase in all of these scenarios.

There are a number of choice estimation tools for estimating inefficiencies. Data Envelopment analysis tool is based on linear programming models. The econometric

models (Bartise and Coeli) are useful, giving individual level observations. The available data is limited to apply these tools. Inefficiencies in applying medicines to treat ARI in under-fives have acquisition cost of the medicines if treatment were optimal according to recommended guidelines. Only the costs of recommended medicines are estimated for this purpose excluding other health care costs. Estimation is done by country within the regions and aggregated by region, sampling the at-risk group (the under-five year olds) of the countries' population. Because the are no valid data on treatments received by cases that did not access formal care in countries, estimation has been done on the proportion of patient who had access to well defined care.

Only incremental costs are estimated (incidence based estimation) because data is inadequate to account for other treatment outcomes. Regional probability data was obtained from the WHO Fact Book summarizing results from studies reported between 1990 and 2006: Medicines use in primary care in developing and transitional countries. From this publication data were obtained on the proportion of cases of URTI infections treated with antibiotics, cases treated according to clinical guidelines, cases treated with cough syrup etc. These data were presented by the Wold Bank regions: Sub-Saharan Africa; East Asia and Pacific; South Asia; Latin America and the Caribbean; and Middle East and Central Asia. Additional probability parameters were obtained form the WHO/ UNICEF guidelines on treatment of ARI in under-fives. Using these probability parameters (proportions) and appealing to Bayesian algebra, a probability tree reflecting the natural treatment choices in the event of ARI was constructed to sequestrate countries' under-five population to mutually exclusive treatment outcomes under the business-as-usual and counterfactual scenarios (figure 1). The counterfactual scenario assumes that all annual new cases have access to effective treatment according to recommended guidelines (UNICEF and WHO). Comparison of these costs provides a rough indication of waste from inappropriate and ineffective access to the appropriate medicines. Cost in each of the tree branches were obtained using this following formula:

Cost per branch = (branch probability) X ((under5 population *incidence of ARI)* (Treatment coverage)) X (episode/annum) year 2010

Results

Tables 1a and 1b contain the incremental cost estimates by WHO regions for medicines to treat ARI giving the business-as-usual scenario and table 2 presents the counterfactual estimates assuming full access to effective and appropriate essential medicines to treat ARI. These WHO regions include: Afro-D, Afro-E, Amro-B Amro-D, Emro-B, Emro-D, Euro-B, Searo-B, Searo-D, and Wpro-B. Estimates are based on the price of medicines on the international market and in international dollar, excluding the freight-on-board (f.o.b), shipping, mark-ups, taxes and other additional charges which are specific to countries.

All estimates are for cost of medicines for those that could access care (adjusted for coverage). Cost of medicines to treat ARI in the under fives in these WHO regions, under the business - as usual scenario is aggregated to $21million of which $4million is due to cost of medicines for the proportion of patients who could access appropriate and effective care while $17million represents cost of medicines for those who had no access to proper care. The implication is that over 80% of the cost of treating ARI in those who accessed care is spent on suboptimal and inefficient care. The estimated cost of the counterfactual (assuming full coverage to appropriate care) is $16million. When compared to the business as usual scenario, about $6million is wasted on inappropriate care.

In comparing these costs to appreciate the level of inefficient use of medicines to treat ARI in under fives, only **17.6%** of the estimated cost of medicines for those who had access to care is due to appropriate and effective treatment. This implies that over 80% of the cost of treatment is inefficiently applied to suboptimal treatments. Total cost of medications giving current treatment (business-as-usual) scenario is **36%** in excess of total cost of medicines that would be incurred if there was full access to appropriate treatment for those who accessed care. Cost estimates for proportion on new cases which had access to effective and appropriate treatment in the current treatment (business-as-usual) scenario represent **24**% of the total cost of medicines giving full access to appropriate medicines.

Discussion

The implication of these results is that inappropriate treatment of under-5 ARI results in excess cost of treatment ranging from 24% - 36% of the cost needed for appropriate treatment of ARI. Also, over 80% of the cost of treatment of ARI is applied to inefficient or suboptimal treatment. These estimates relate only to the acquisition cost of the medicines for treating ARI in the under-fives. Other health system related costs have not been included.

Additional work

This estimation could be extended to reflect the uncertainties in these estimates, and in determining the contribution of important variables to the estimates. For instance, it would be informative to determine how variations in coverage rates (access to appropriate treatment) would affect these estimates.

Table 1a. Estimates of cost of medicines for patients with access to effective treatment by region.

Aggregation by WHO region

	Severe Pneumonia	**Moderately severe pneumonia**	**Pneumonia**	**Upper respiratory tract infection (common cold)**
AfrD	$216,617	$27,310	$61,120	$292,811
AfrE	$200,249	$25,246	$56,501	$270,686
AmrB	$72,061	$9,085	$20,332	$97,407
AmrD	$17,193	$2,168	$4,851	$23,241
EmrB	$49,607	$6,254	$13,997	$67,056
EmrD	$49,841	$6,284	$14,063	$67,372
EurB	$433	$55	$122	$585
SearB	$102,725	$12,951	$28,984	$138,858
SearD	$392,458	$49,479	$110,734	$530,503
WprB	$256,238	$32,305	$72,299	$346,368
Total by severity	$1,357,420	$171,136	$383,003	$1,834,887
			Grand total	***$3,746,447***

Table 1b. Estimates of cost of medicines for patients with poor access to effective treatment by region.

WHO Regions	No of countries	Severe Pneumonia	Moderately severe pneumonia	Pneumonia	Upper respiratory tract infection (common cold)		
					Analgesics	*Antibiotics*	*Cough syrup*
AfrD	29	$288,336	$36,352	$212,052	$389,757	$641,111	$37,182
AfrE	20	$265,446	$33,466	$195,219	$358,816	$596,022	$33,092
AmrB	26	$75,845	$9,562	$55,779	$102,523	$120,485	$14,214
AmrD	6	$16,257	$2,050	$11,956	$21,975	$27,351	$3,025
EmrB	12	$80,572	$10,158	$59,255	$108,912	$121,943	$16,239
EmrD	4	$66,009	$8,322	$48,545	$89,227	$117,947	$13,607
EurB	1	$800	$101	$588	$1,081	$979	$154
SearB	7	$201,044	$25,347	$147,855	$271,761	$253,074	$37,121
SearD	7	$2,060,403	$259,765	$1,515,293	$2,785,141	$3,358,847	$196,556
WprB	22	$447,715	$56,446	$329,266	$605,197	$560,620	$86,202
Total	134	$3,502,426	$441,567	$2,575,808	$4,734,390	$5,798,380	$437,39
					Grand total		***$17,489,965***

Table 2. Estimates of cost of medicines for assuming full access to effective treatment (counter factual) by region.

	Severe Pneumonia	Moderately severe pneumonia	Pneumonia	Common cold (Paracetamol)
AfrD	$504,953	$63,662	$371,360	$682,568
AfrE	$465,696	$58,712	$342,489	$629,502
AmrB	$147,905	$18,647	$108,775	$199,930
AmrD	$33,450	$4,217	$24,600	$45,215
EmrB	$130,178	$16,412	$95,738	$175,968
EmrD	$115,850	$14,606	$85,200	$156,599
EurB	$1,232	$155	$906	$1,666
SearB	$303,769	$38,298	$223,403	$410,619
SearD	$2,452,861	$309,244	$1,803,921	$3,315,644
WprB	$703,953	$88,751	$517,712	$951,565
Total by severity	$4,859,847	$612,703	$3,574,103	$6,569,277
			Grand Total	***$15,615,931***

Figure 1. ARI treatment Probability tree.