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The annual global economic burden of heart failure☆

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ABSTRACT

Background: Heart failure (HF) imposes both direct costs to healthcare systems and indirect costs to society through morbidity, unpaid care costs, premature mortality and lost productivity. The global economic burden of HF is not known.

Methods: We estimated the overall cost of heart failure in 2012, in both direct and indirect terms, across the globe. Existing country-specific heart failure costs analyses were expressed as a proportion of gross domestic product and total healthcare spend. Using World Bank data, these proportional values were used to interpolate the economic cost of HF for countries of the world where no published data exists. Countries were categorized according to their level of economic development to investigate global patterns of spending.

Results: 197 countries were included in the analysis, covering 98.7% of the world's population. The overall economic cost of HF in 2012 was estimated at $108 billion per annum. Direct costs accounted for ~60% ($65 billion) and indirect costs accounted for ~40% ($43 billion) of the overall spend. Heart failure spending varied widely between high-income and middle and low-income countries. High-income countries spend a greater proportion on direct costs: a pattern reversed for middle and low-income countries.

Conclusions: Heart failure imposes a huge economic burden, estimated at $108 billion per annum. With an aging, rapidly expanding and industrializing global population this value will continue to rise.

1. Introduction

In nearly all regions of the world HF is both common and increasing [1,2]. Although death rates from cardiovascular disease (CVD) as a whole have declined, HF is the only major CVD whose prevalence and incidence are thought to be increasing [3] and the long-term prognosis associated with HF is poor [4].

As the global problem of HF increases, there is also the significant economic burden of disease to be considered. It is increasingly important for governments and health organizations to have an estimate of the costs attributed to HF, as they will have to plan, predict and finance the care of a rapidly growing and aging global population.

The economic impact of a disease is considered in terms of direct and indirect costs. Direct costs include healthcare expenditure on hospital services, medications, physician costs, primary healthcare costs and follow-up. Indirect costs include healthcare expenditure in terms of lost productivity resulting from morbidity and mortality, sickness benefit and welfare support.

Although some data on the prevalence and cost of HF exists, this is scarce and largely limited to the high-income countries of Western Europe and North America. There is almost a complete lack of data regarding middle to low-income countries, despite the fact they represent over 80% of the world's population.

The objective of this study was to calculate, from available information, a best estimate of the overall cost of HF per annum, in both direct and indirect terms, across the globe.

2. Methods

2.1. Direct and indirect HF costs sources

A literature review of studies assessing the crude prevalence rates and economic burden of HF was performed using the MEDLINE database. The terms *heart failure*, *myocardial failure*, *congestive heart failure* and medical subject headings *economics*, *statistics and numerical data* were used and abstracts reviewed for relevance (Fig. 1).

In addition, data from government department of health documents, professional society reports and non-profit organization reports were included and referenced accordingly. The most up-to-date sources were used. Only data pertaining specifically to HF economic burden were included. No extrapolations or presumptions based on overall CVD burden were made.

Local currency values of direct and indirect HF costs were converted into US dollars ($) at the mean annual exchange rate for the year of study.

2.2. Comparing direct and indirect HF costs

To compare the direct cost burden of HF across collated sources, cost values were expressed as a percentage of the country's total health expenditure. Total health expenditure is defined by the World Health Organization as: the sum of public and private health expenditure, covering the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health [5].

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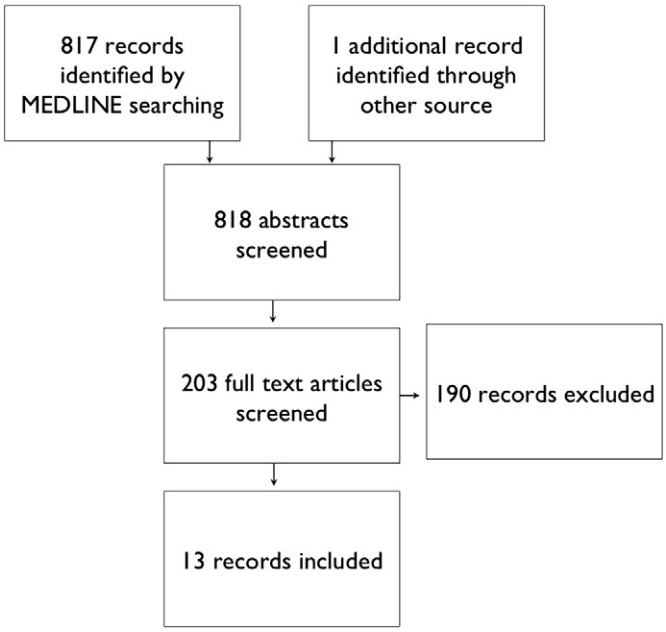

Fig. 1. Flow diagram of literature search.

All estimates of country specific total health expenditure were derived from World Bank data sources, which expressed these values as a percentage of GDP. Values of GDP ($) were obtained from the World Bank and backdated to the year of study. These values were multiplied by the percentage spent on healthcare to calculate the total health expenditure in US dollars. An individual country's HF cost burden ($) could then be expressed as a percentage of its total health expenditure (Fig. 2). This method provided each country a measure of its economic burden of HF that took into account both its wealth and its willingness to spend that wealth on healthcare. Being expressed as a percentage, it also allowed comparison between different countries.

Indirect costs were expressed as a percentage of GDP rather than total health expenditure, to better reflect the lost productivity through morbidity, premature mortality and welfare impact on others outside of allocated healthcare funds.

2.3. Different levels of economic development

Total health expenditure (and thus expenditure on HF) is dependent on a country's economic level of development. The World Bank Development Indicators (WDI) are compiled from officially recognized international sources and comprise the most current and accurate global development data available [6]. Countries are classified as high, middle or low-income.

The available economic sources were stratified according to the country of study by WDI (Table 2). Because there are no published data sources from low-income countries, middle and low-income countries were grouped together for further analysis. This produced two groups: 'high-income' countries and 'middle and low-income' countries.

- **Country**
  - USA
- **Published estimate of HF cost (2012)**
  - $30,700,000,000
- **World Bank GDP (2012)**
  - $ 15,684,800,000,000
- **World Bank % GDP spent on healthcare (2012)**
  - 17.9%
- **Total health expenditure:**
  - 15,684,800,000,000 * 0.179 = **$ 2,800,486,020,861**
- **HF cost burden as a percentage of total health expenditure:**
  - (30,700,000,000/2,800,486,020,861)*100 = **1.10%**

Fig. 2. Comparing HF costs across published resources: worked example for USA, (direct and indirect costs), 2012.

2.4. Calculating the global direct and indirect economic burden of HF

The mean direct HF cost burden value (expressed as a % of total health expenditure) of the published sources was calculated for both 'high-income' and 'middle and low-income' groups. These mean values (that differentiated the level of healthcare spending between high and middle and low-income economies) were used to estimate the direct economic burden of HF in US dollars of any other given country; based on that country's WDI rating, GDP and total health expenditure. The sole published indirect HF cost burden (expressed as a % of GDP) was applied similarly in this way (Fig. 3).

WDI, GDP and total healthcare expenditure were obtained for all countries from World Bank National Accounts Data for the year 2012 and the estimation of their individual direct and indirect HF cost burden calculated as described above [7]. Countries were excluded from study depending on availability of World Bank data on GDP and/or total health expenditure.

The sum of these values was calculated to provide an estimate of the global economic burden of HF in the year 2012. These estimates were further grouped by WDI to provide comparison between high and middle and low-income countries. Per capita values were calculated by dividing a country's expenditure on HF by its population. Population estimates were taken from The World Bank total population database for the year 2012 [8]. Countries were further ordered and ranked in a variety of ways according to different measures of interest.

3. Statistics

Where relevant, comparisons between mean values of groups were made using the Student paired *t* test. A p value <0.05 was pre-defined as statistically significant.

4. Results

4.1. Data sources

13 published economic estimates of healthcare costs attributed specifically to HF were included in the study. Only 1 source (American Heart Association Statistics Committee and Stroke Statistics Subcommittee Heart Disease and Stroke Statistics Report, 2013) included indirect HF costs [9] (Table 1). Study estimates spanned a range of 22 years. The earliest economic estimate was from 1990 and the latest 2012.

Published economic estimates were predominantly from the USA, Europe and Australasia, with a resultant heavy bias towards high-income ($n = 12$) versus middle and low-income ($n = 1$) countries of study (Table 2).

World Bank population and national accounts data provided population, GDP and total health expenditure statistics for 213 countries. 16 countries were excluded because of incomplete data (American Samoa, Cayman Islands, Channel Islands, Curacao, French Polynesia, Guam, Isle of Man, Korea Democratic Republic, Myanmar, New Caledonia, Northern Mariana Islands, St. Martin, Somalia, Turks and Caicos Islands, Virgin Islands and West Bank and Gaza). 92.4% of all global countries and 98.7% of the world's population in 2012 were thus included for study.

4.2. Direct and indirect HF costs

The mean direct HF cost burden value (expressed as a % of total health expenditure per annum) of all published sources was 1.32%. When the published sources were stratified according to country WDI status, mean direct HF cost burden value (expressed as a % of total health expenditure per annum) of high-income countries was 1.42% and middle and low-income countries was 0.11%. The indirect HF cost burden value was calculated as 0.06% of GDP.

Total global HF costs in 2012 was estimated at $108 billion. Direct costs accounted for ~$65 billion (60%) and indirect costs ~$43 billion (40%) per annum (Table 3). Global per capita spending in 2012 was approximately $23.81/annum.