Valuation of Costs in Health Economics During Financial and Economic Crises: A Case Study from Lebanon

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Abstract

In 2019, we embarked on a study on the economic burden of multiple sclerosis (MS) in Lebanon, in collaboration with a premier Lebanese MS center. This coincided with a triple disaster in Lebanon, comprising the drastic economic and financial crisis, the COVID-19 pandemic, and the consequences of the explosion of Beirut’s port. Specifically, the economic and financial turmoil made the valuation of costs challenging. Researchers could face similar challenges, particularly in low- and middle-income countries (LMICs) where economic crises and recessions are recurrent phenomena. This paper aims to discuss steps taken to overcome the fluctuation of the prices of resources to get a valid valuation of societal costs during times of a financial and economic crisis. In the absence of local costing data and guidelines for conducting cost-of-illness (COI) studies, this paper provides empirical recommendations on the valuation of costs that are particularly relevant in LMICs. We recommend (1) clear reporting and justification of the country-specific context, year of costing, assumptions, data sources, and valuation methods, as well as the indicators used to adjust cost for inflation during different periods of fluctuation of prices; (2) collecting prices of each resource from multiple and various sources; (3) conducting a sensitivity analysis; and (4) reporting costs in local currency and Purchasing Power Parity dollars (PPP$). Precision and transparency in reporting prices of resources and their sources are markers of the reliability of the COI studies.

Key Points

Future studies in low- and middle-income countries (LMICs) should strive to present reliable cost estimates adapted to their country’s specific context, despite challenges. Precision and transparency in reporting prices of resources and their sources are markers of the reliability of the cost-of-illness (COI) studies.

Prices of each resource included in the COI study must be collected from multiple and various sources reflecting the different existing socioeconomic classes to obtain reflective average market prices.

Health economics studies should adjust costs collected during different periods of fluctuation of the purchasing power of a currency to account for inflation, and report costs in dollars ($) using the purchasing power parity (PPP) conversion rate rather than the exchange rate to enhance comparability among countries.
in Lebanon [3], concomitant with a period of hyperinflation and the deterioration of the Lebanese Pound (LBP). The prevailing Lebanese economic and financial turmoil made the valuation of costs for MS patients challenging, especially in the absence of local Health Technology Assessment (HTA) infrastructure and guidelines [4, 5]. The implications of the financial and economic crisis made it unfeasible to realize our initial valuation plan [3]; hence, we explored various scenarios for meeting these challenges. While there are well-established guidelines explaining the valuation of costs in health economics [6–8], they do not address methodologies to adopt in times of financial and economic crises. As many researchers could face similar challenges, particularly in low-and middle-income countries (LMICs) where economic crises and recessions are recurrent phenomena [9], reporting on our efforts to overcome the fluctuation of resource prices in our study could be valuable for future research. Accordingly, this paper aims to explain and discuss steps taken to get a valid valuation of societal costs and provide recommendations for valuating costs in periods of financial and economic crisis characterized by high fluctuations in price.

2 Country-Specific Context: The Lebanese Triple Disaster

The triple disaster is likely to influence the consumption and prices of health resources. Thus, understanding the country-specific context must facilitate interpreting the results in light of these circumstances.

2.1 Economic and Financial Crisis in Lebanon

The prevailing complex economic and financial crisis in Lebanon is attributed to many deteriorating macro-environmental factors that exacerbated the decline of the economy, such as the Syrian civil war, the unstable geopolitical environment, corruption, and the failure of consecutive governments to implement necessary reforms [10, 11]. Following a proposal to introduce new taxes, an antigovernment protest took place in October 2019 [12]. This was followed by restrictions on bank withdrawals, and unauthorized capital controls, and deduction on deposits [10], preventing people from accessing their savings. The currency has lost more than 90 % of its value since 2019, having been pegged to the US dollars (US$) at a rate of 1507 LBP in 1997 and 2019, and reaching a low of more than 33,000 LBP to the US$ at the end of 2021 on the black market. Moreover, a multiple exchange rate approach existed which worsened the situation. The World Bank described the Lebanese economic and financial crisis as possibly among the world’s three worst since the middle of the nineteenth century [2].

Lebanon’s nominal Gross Domestic Product (GDP) plummeted from about US$55 billion in 2018 to US$33 billion in 2020, and declined to around US$22 billion in 2021, with US$ GDP per capita falling by around 60 % [2, 13].

The currency depreciation saw average salaries in LBP plummet and demolished purchasing power in a country dependent on imports [14]. The average annual inflation rate for the year 2021 reached 154.8 % compared to 84.9 % in 2020 according to the consumer price index (CPI) issued by the Lebanese Central Administration of Statistics (CAS) [15]. The soaring inflation made Lebanon rank third highest globally behind Venezuela and Sudan [2]. Figure 1, showing the CPI progression per quarter, illustrates the evolution of prices for goods and services consumed by households during the period of data collection and the year of costing 2021. The overall CPI and health CPI curves show the gradual inflation progression up to the first quarter (Q1) of 2021, and the climb in Q2 when the phasing out of subsidies began and when it was in full force in Q3 and Q4 2021 [15].

The influx of significant numbers of Syrian refugees in the past decade placed a heavy burden on the Lebanese Healthcare System [16]. Lebanon’s economic and financial meltdown imposed a crippling effect on the healthcare sector, including healthcare professionals, healthcare providers, medical equipment, and pharmaceutical supplies; thus, affecting patients’ access to health services [17]. The drop in the purchasing power of salaries in LBP resulted in many physicians and nurses leaving the country and seeking employment abroad [14, 15], while patients reduced their expenditures on both preventive and primary healthcare services [18]. On top of that, in 2019 and 2020 the government was unable to refund US$1.3 billion owed to private hospitals, which provide more than 80 % of Lebanon’s healthcare services [19]. Obtaining dollars from the black market for imports on an expensive exchange rate resulted in a shortage of medications and medical equipment [17, 19]. In addition, the Lebanese Central Bank gradually halted health subsidies at the end of 2020 due to the depletion of foreign reserves [17].

2.2 COVID-19 Pandemic

The outbreak of COVID-19 further aggravated the burden of the Lebanese healthcare sector [17]. The already suffering sector was overwhelmed by cases and hospital capacity was pushed to the limit. The pandemic came at a hard time in Lebanon when hospitals were not prepared at all [20], and health resources were depleted due to the implications of consecutive socio-economic crises. Hospitals scaled back and postponed non-emergency care to focus on COVID-related cases [19]. Furthermore, the fear of contracting COVID, and the lockdowns and curfews imposed by the Lebanese government limited patients’ regular visits.
to health providers and diminished non-emergency surgeries and preventive health care. Moreover, the pandemic had adverse ripple economic consequences on the healthcare system as well as the economy in general [20].

### 2.3 The Explosion of Beirut’s Port

The explosion of Beirut’s port on 4 August 2020 resulted in more than 200 deaths and over 6000 injuries, with more than 300,000 individuals made homeless [21]. These casualties overwhelmed the health system that was already reeling from a socio-economic crisis and the ongoing COVID-19 pandemic. In addition to the devastating social and economic consequences, the blast caused severe damage to the critical health infrastructure. Three hospitals were substantially damaged, while another three hospitals became non-functional, with 500 hospital beds lost. In addition, 17 containers with essential medical supplies stored at Beirut port were destroyed [21]. The World Bank estimated the economic loss and physical damage at US$8 billion equivalent to 24% of the GDP [22].

### 3 Methods Adopted to Obtain a Valid Valuation of Costs in Times of Financial and Economic Crisis

Amid the dire situation in Lebanon, data on the consumption of health care and services, formal care, informal care, and workforce participation were collected from MS patients during clinical visits, using an MS health resource utilization questionnaire [3]. The study protocol and HTA methods used in estimating the burden of MS were published [3].

We faced several challenges in the valuation of costs as information on health costs is not publicly available in Lebanon, in an already fragmented market. Moreover, the economic and financial crisis aggravated the volatility and hyperinflation of health care and other resource prices, which were changing, sometimes, on a weekly basis. Specifically, the financial turmoil also resulted in different prices of the same resource in the market.

In order to value the costs amid the financial and economic crisis, several steps were taken. The following is a discussion of steps taken in the valuation of costs to overcome the challenges associated with the Lebanese crises; (1) collecting and validating prices of health care and other resources included in the COI study, (2) clearly defining data sources and conducting a sensitivity analysis, and (3) converting the devalued LBP using the purchasing power parity (PPP) rate. Then, within the discussion, these steps are formulated as specific recommendations to get a valid valuation of costs in LMICs during times of economic and financial crisis, in addition to general recommendations to be applied in COI studies in these LMICs in the absence of local guidelines.

#### 3.1 Collecting and Validating Prices

The Lebanese country-specific context and factors associated with the crises are likely to impact the consumption of health resources and the total cost of MS. Thus, these factors were considered in our methods and in interpreting the results.

Lebanese healthcare coverage is based on several types of insurance and third-party payers, each having their own percentage of coverage and tariff. Since the market prices of health resources were increasing throughout the period of the data collection, while the percentage of coverage and tariffs paid by third-party payers remained unchanged in 2021 despite the hyperinflation, we opted to use the average market prices of health resources. These market prices reflect the bigger portion of the health bill paid by patients.
as out-of-pocket expenses, and the smaller portion covered by third-party payers. Accordingly, to overcome the market chaos of different prices of the same resource, we conducted a survey to collect the market prices for health care and other resources in our 2021 COI inventory. Prices were collected from multiple and various sources (detailed below) to get reflective market prices of the different existing socioeconomic classes. The average of these prices was calculated for the analysis. The final list of average market prices used in the valuation of costs was justified by two clinical neuroligators practicing at the premier Lebanese MS center, and experts in health economics (RR, JD) and economics (KH, AN) in Lebanon. Consensus to justify the final list was reached by discussion with these experts.

3.2 Clearly Defining Data Sources and Conducting a Sensitivity Analysis

Data were collected on health care and service consumption amid a period of hyperinflation. It was not realistic to adopt 2020 prices for data collected during 2021 when the economic crisis deepened. In particular, excessively high prices starting from July 2021—when the Lebanese government started lifting subsidies on most goods and services—were found to be inflated relative to the market price during the period of data collection, especially since data were collected retrospectively in a 3- to 12-month time frame. Accordingly, the average market prices of health resources in the first 6 months of 2021 were thought to reflect the prevailing Lebanese situation during the period of data collection. This was our first scenario based on the average market price in the first six months of 2021. To test the robustness of our cost results, we conducted a sensitivity analysis, in which we calculated a second scenario based on the average market price in the second six months of 2021. Thus, we calculated two sets of data for all costs included in this study: minimum cost (first scenario—before subsidies were lifted), and maximum cost (second scenario—after subsidies were lifted).

The average market prices for health resources were obtained from key informant interviews with three hospitals from different Lebanese governates for ‘tests’ and ‘consultations’, and four hospitals for ‘hospitalization’. To reflect the market price, costs were collected from main hospitals in Beirut and Mount Lebanon, and from a community-based hospital in Beirut. The unit costs of medications were obtained from the Lebanon National Drugs Database issued and updated by the Ministry of Public Health [23]. For the first scenario, we calculated medication costs based on the June 2021 market price, while for the second scenario we considered the December 2021 market price (after subsidies were halted). Investments in equipment and modifications, and transportation costs were calculated based on the average market price in the first and second half of 2021, before and after subsidies were lifted on fuel and most goods and services. Out-of-pocket expenses reported by patients in US$ were calculated in the first scenario based on the average exchange rate in the first 6 months of 2021 (US$1 = 11,633 LBP), and in the second scenario based on the average exchange rate in the second 6 months of 2021 (US$1 = 22,000 LBP).

While multiple exchange rates existed in the market, the official exchange rate set by the Lebanese Central Bank during 2021 was 3900 LBP per US$1 (Circular No. 151). Although this was the lowest rate in the market, it was reflective of monthly wages as many Lebanese organizations who paid salaries in US$ before the financial crisis where paying salaries based on that rate.

The unit cost per hour of informal care was calculated based on the proxy good method [24]; for the first scenario we used the Lebanese minimum wage for the year 2021, which is 675,000 LBP [25]; equivalent to US$450 based on the exchange rate before the financial crisis (US$1 = 1507 LBP). Informal care was recalculated for the second scenario based on the exchange rate of 3900 LBP per US$1 set by the Lebanese Central Bank (minimum wage = US$450 × 3900 LBP = 1755,000 LBP).

Productivity losses for MS patients were estimated using the human capital approach [26], whereby the average national gross monthly wage of 2,280,000 LBP (equivalent to US$1520 based on the exchange rate before the financial crisis US$1 = 1507 LBP) was estimated to be the cost of employment for the first scenario in the absence of national estimates; this was recalculated for the second scenario based on the exchange rate of 3900 LBP per US$1 set by the Lebanese Central Bank (average monthly salary = US$1520 × 3900 LBP = 5,928,000 LBP).

3.3 Adjusting Costs for Inflation and Reporting Costs in Purchasing Power Parity Dollars (PPPS)

Cost estimates for both scenarios were presented and evaluated in light of the evolutions of the CPI. The estimated costs in the devalued LBP reflect the economic burden in the year of costing. However, the value of LBP continues to deteriorate given the worsening Lebanese crisis; hence, costs in LBP in our study do not serve as valid comparators with costs in other studies. The purchasing power parity (PPP) is the rate of the yearly currency conversion used to transfer the cost of a comparable basket of goods and services into a common currency in PPPS; thus, eliminating the differences in the price levels across countries [27]. The PPP exchange rates are issued by the World Bank; they are relatively stable over time and facilitate comparison of the costs of resources across countries [28]. The estimated societal costs of MS in 2021 were presented in LBP and then converted to PPPS using the World Bank PPP exchange rate.
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(1 PPP$ = 2958.13) [29] to allow comparison with similar studies from other countries and for readers worldwide to grasp the economic burden of MS in Lebanon.

4 Discussion

While there are well-established guidelines for costing in HICs [6–8], challenges associated with the valuation of costs in health economics are inherent in LMICs, especially given the absence of a formal structure and guidelines for HTA [4, 5] and the lack of data on costing [30]; this worsens during times of financial and economic crisis. In this paper, we report our approaches for valuating costs during times of financial and economic crisis characterized by fluctuation of prices. Methodologies used in this paper were applied in a separate paper, where we presented the estimated societal costs of MS in Lebanon.

We strived to craft a valid valuation approach amid the financial and economic crisis by using recommended and validated methods used in COI studies, such as conducting a sensitivity analysis, adjusting costs for inflation, and reporting costs in PPP$. Several COI studies conducted sensitivity analyses [31–35] to explore different scenarios in estimating costs. Adjusting for inflation and converting local currencies to PPP$ are becoming a necessity within health economic studies [36, 37] to enhance comparability of cost estimates collected from different countries in different years [4, 35, 38]. Additionally, the Cochrane Handbook [39] recommended presenting costs’ results using the PPP while converting cost estimates of a target currency to a fixed price year.

The authors acknowledge the limitations of all assumptions related to valuating the costs of resource consumption for MS patients. Given the market turmoil, it was challenging to accurately reflect black market prices and consider the

Table 1  Recommendations to overcome general and specific challenges in the valuation of costs in health economics studies

| Key challenges                                      | Recommendations                                                                                                                                                                                                 |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General recommendations for COI studies in LMICs   | The country-specific context and associated factors should be clearly described so that the reader will be able to consider, understand, and interpret the results in light of these circumstances |
| Understanding the country-specific context         | The year of costing, assumptions, data sources for included costs, and valuation methods should be clearly defined and described as a marker of reliability. Data sources used should be clearly referenced and validated with key informant interviews, and by clinical and economic experts. It is important to discuss the adopted approach while considering associated advantages and limitations pertaining to the country context |
| Ambiguous estimation of costs and suboptimal transparency in costing are common shortcomings of COI studies [4] | Prices of each resource must be collected from multiple and various sources reflecting the different existing socioeconomic classes to obtain reflective average market prices During volatile market periods characterized by wide price fluctuations, it is crucial to consider different plausible scenarios. As valuation of costs during an economic crisis will be based on a number of assumptions creating uncertainties, conducting a sensitivity analysis must formalize ways to quantify and qualify these uncertainties by determining how different values of each unit cost affect the results within a given set of assumptions [40, 41] Health economics studies should adjust costs collected during different periods of fluctuation of the purchasing power of a currency to account for inflation. The methodology used to adjust for inflation and express costs in a single reference year should be reported transparently [36]. This will allow future studies to understand the cause of variation in the value of resources being used and the change in the currency purchasing power [42] |
| Specific recommendations during times of economic and financial crisis in LMICs | The absence of local costing data and guidelines on how to overcome challenges related to high rates of inflation and fluctuating market prices of resources and exchange rates in LMICs restricts the comparison of cost estimates among these countries [30]. To avoid variation in currency conversion, it is advisable to report costs in PPP$ [36, 39], in addition to local currency |

COI cost-of-illness, LMIC low-and middle-income countries, PPP$ Purchasing Power Parity dollars
fully subsidized values of some resources. Thus, defining prices for each health resource and other services, amid the triple disaster in Lebanon marked by an unstable economic situation, might include bias in slightly underestimating the cost. Additionally, some costs, such as the average national gross monthly wage and informal care costs, were estimated in the absence of national data. However, under these difficult circumstances, where assumptions are infinite, having all costs calculated under two sets of assumptions based on the two six-month market price averages (before and after subsidies were lifted) was thought to be the most thorough method for reflecting the prevailing Lebanese context. The same approach used in the valuation of costs might not be applicable in the same country for the year of costing 2022, as the study context and factors associated with the crises have changed. However, several recommendations can be deduced; these might be applied in similar LMICs in general and specifically in time of financial and economic crisis. Table 1 summarizes general challenges in conducting COI studies in LMICs, and specific challenges to get a valid valuation of costs in health economics studies during financial and economic crisis, and pertaining recommendations to each set of challenges.

5 Conclusion

In the absence of local costing data and guidelines for conducting and reporting on COI studies in LMICs, this paper provides empirical recommendations on the valuation of costs in these countries, especially during times of a financial and economic crisis. The methodology described in this paper could be followed by other researchers in LMICs in times of economic and financial crisis; nevertheless, it should be adapted to their country-specific contexts. Our recommendations seek to enhance generalizability and comparability of results among LMICs, especially during financial and economic crises, by increasing transparency in reporting the used methodologies and converting costs into a common currency (PPPS) rather than using the exchange rate. Future studies in LMICs should strive to present reliable cost estimates adapted to their country’s specific context, despite challenges. Precision and transparency in reporting prices of resources and their sources are markers of the reliability of the COI studies. Moreover, we expect our findings to foster discussion on the importance of transparent and detailed reporting and justification of costing methodologies and approaches in health economics to facilitate comparison among studies.

Declarations

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Availability of data and material Not applicable.

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References

1. Fullman N, Yearwood J, Abay SM, Abbafati C, Abd-Allah F, Abdela J, et al. Measuring performance on the Healthcare Access and Quality Index for 195 countries and territories and selected subnational locations: a systematic analysis from the Global Burden of Disease Study 2016. The Lancet. 2018;391:2236–71.
2. World Bank Group, Middle East and North Africa Region, Lebanon Economic Monitor, Lebanon Sinking (To the Top 3), Spring 2021. 2021. Lebanon Economic Monitor. Spring 2021 : Lebanon Sinking (to the Top 3) (worldbank.org). Accessed Sep 2022.
3. Dahham J, Rizk R, Hiligsmann M, Daccache C, Khoury SJ, Darwish H, et al. The Economic and societal burden of multiple sclerosis on lebanese society: a cost-of-illness and quality of life study protocol. Expert Rev Pharmacoecon Outcomes Res. 2021;22:1–8.
4. Dahham J, Rizk R, Kremer I, Evers SMAA, Hiligsmann M. Economic burden of multiple sclerosis in low- and middle-income countries: a systematic review. Pharmacoeconomics. 2021;39:789–807.
5. Daccache C, Rizk R, Dahham J, Evers SMAA, Hiligsmann M, Karam R. Economic evaluation guidelines in low- and middle-income countries: a systematic review. Int J Technol Assess Health Care. 2022;38: e1.
6. Drummond MF, et al. Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press; 2015.
7. Glick HA, Doshi JA, Sonnad SS, Polsky D. Economic evaluation in clinical trials. Oxford, 2014.
8. Griffiths UK, Legood R, Pitt C. Comparison of economic evaluation methods across low-income, middle-income and high-income countries: what are the differences and why?: economic evaluation methods: differences across country income groups. Health Econ. 2016;25:29–41.
9. Andrietta LS, Levi ML, Scheffer MC, Alves MTSS de B, de Oliveira BLAC, Russo G. The differential impact of economic recessions on health systems in middle-income settings: a comparative case study of unequal states in Brazil. BMJ Glob Health. 2020;5:e002122.

10. The Lebanese Government Financial Recovery Plan Executive Summary 2018.pdf. The Lebanese Government Financial Recovery Plan.pdf (finance.gov.lb). Accessed Feb 2022.

11. Elia J. Lebanese banks: a factor of the current Lebanese financial crisis (2019–2020). (5) (PDF) Lebanese banks: a factor of the current lebanese financial crisis (2019–2020) (researchgate.net). Accessed Sept 2022.

12. Mora N. A primer on the financial crisis in Lebanon: a historical and cross-country perspective. SSRN Electron J [Internet]. 2020 [cited 2022 Mar 18]; https://www.ssrn.com/abstract=3527443

13. World Bank. 2022. Lebanon Public Finance Review. © World Bank Group, European Union, United Nations. Beirut Rapid Damage and Needs Assessment [Internet]. World Bank, Washington, DC; 2020 [cited 2022 Mar 18]. http://hdl.handle.net/10986/34401

14. Wehbi M. COVID19: impact on lebanese economy. Int J Res Sci. 2020;9(4):1648–52.

15. Central Administration of Statistics, Economic statistics. 2022. Central Administration of Statistics—Economic statistics (cas.gov.lb) Accessed Feb 2022.

16. Hamdar B, Saab H, Zaher H, El Baset O, Hamdar Z, et al. Economic modelling of the effects of Syrian refugees on the Lebanese economy. Int J Economics Commerce Manag. 2018;VI:11.

17. Arab Reform Initiative. Saving the suffering lebanese healthcare sector: immediate relief while planning reforms. Saving the suffering lebanese healthcare sector: immediate relief while planning reforms – arab reform initiative (arab-reform.net). Accessed Sept 2022.

18. Devi S. Lebanon faces humanitarian emergency after blast. Lancet. 2020;396:456.

19. Mjaess G, Karam A, Chebel R, Tayeh GA, Aoun F. COVID-19, the economic crisis, and the Beirut blast. East Mediterr Health J. 2021;27:535–7.

20. Bizri AR, Khachfe HH, Fares MY, Musharrafieh U. COVID-19 pandemic: an insult over injury for Lebanon. J Community Health. 2021;46:487–93.

21. WHO 2020. 2020. https://www.who.int/docs/default-source/documents/emergencies/who-leb-partners-update-18-august-2020.pdf?sfvrsn=820c93ad_4. Accessed Feb 2022.

22. World Bank Group, European Union, United Nations. Beirut Rapid Damage and Needs Assessment [Internet]. World Bank, Washington, DC; 2020 [cited 2022 Mar 18]. http://hdl.handle.net/10986/34401

23. Health Care System.2021. https://www.moph.gov.lb/en/Drugs/index/3/4848/lebanon-national-drugs-database#/en/view/58026/drugs-public-price-list. Accessed Feb 2022.

24. Malawi Consortium, Chiwaula LS, Chirwa GC, Calrado F, Kapito-Tembo A, Hosseinipour MC, et al. The value of informal care in the context of option B+ in Malawi: a contingent valuation approach. BMC Health Serv Res. 2016;16:136.

25. Tufaro R. A historical mapping of lebanese organized labor: tracing trends, actors, and dynamics. Civ Soc Knowl Cent [Internet]. 2021 [cited 2022 Mar 21];1. https://civilsociety-centre.org/paper/historical-mapping-lebanese-organized-labor-tracing-trends-actors-and-dynamics

26. Hodgson TA. Costs of illness in cost-effectiveness analysis: a review of the methodology. Pharmacoeconomics. 1994;6:536–52.

27. Nyengar S, Tay-Teo K, Vogler S, Beyer P, Wiktor S, de Jonchere K, et al. Prices, costs, and affordability of new medicines for hepatitis C in 30 countries: an economic analysis. PLOS Med. 2016;13:e1002032.

28. International Monetary Fund. PPP versus the market: which weight matters? March 2007https://www.imf.org/external/pubs/ft/fandd/2007/03/basics.htm. Accessed Feb 2022.

29. PPP conversion factor, GDP (LCU per international $)—Lebanon. 2020. https://data.worldbank.org/indicator/PA.NUS.PPPLocations=LB. Accessed Sep 2022.

30. GEAR.2022. http://www.gear4health.com/gear/difficulties-in-conducting-health-economic-evaluations. Accessed Sep 2022.

31. Rizk R, Hiligsmann M, Karavetian M, Salameh P, Evers SMDA. A societal cost-of-illness study of hemodialysis in Lebanon. J Med Econ. 2016;19:1157–66.

32. Gyllensten H, Wiberg M, Alexanderson K, Friberg E, Hillert J, Tinghög P. Comparing costs of illness of multiple sclerosis in three different years: a population-based study. Mult Scler J. 2018;24:520–8.

33. Toscano C, Sugita T, Rosa M, Pedrosa R, Rosa B, Bahia L. Annual direct medical costs of diabetic foot disease in brazil: a cost of illness study. Int J Environ Res Public Health. 2018;15:89.

34. Jin H, Wang H, Li X, Zheng W, Ye S, Zhang S, et al. Economic burden of COVID-19, China, January–March, 2020: a cost-of-illness study. Bull World Health Organ. 2021;99:112–24.

35. Schriever D, Haase R, Ness N-H, Ziemssen T. Cost of illness in multiple sclerosis by disease characteristics—a review of reviews. Expert Rev Pharmacoecon Outcomes Res. 2022;22:177–95.

36. Turner HC, Lauer JA, Tran BX, Teenawattananon Y, Jit M. Adjusting for inflation and currency changes within health economic studies. Value Health. 2019;22:1026–32.

37. Mattingly TJJ, Weathers S. Drug costs in context: assessing drug costs in cost-of-illness analyses. Drugs Context. 2022;11:1–7.

38. Ernstsson O, Gyllensten H, Alexanderson K, Tinghög P, Friberg E, Norlund A. Cost of illness of multiple sclerosis—a systematic review. PLoS ONE. 2016;11:e0159129.

39. Cochrane Handbook for Systematic Reviews of Interventions. 2022. https://handbook-5-1.cochrane.org Accessed Sep 2022.

40. Saltelli A, editor. Sensitivity analysis in practice: a guide to assessing scientific models. Hoboken: Wiley; 2004.

41. Bai G, Davd AP. Probabilistic sensitivity analysis in health economics. Stat Methods Med Res. 2015;24:615–34.

42. Kumaranyake L. The real and the nominal? Making inflationary adjustments to cost and other economic data. Health Policy Plan. 2000;15:230–4.
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