DOI: 10.7860/JCDR/2026/79251.22418

Review Article

Health Management and Policy Section

Cost Considerations in Healthcare: Review Analysis of Break-even Point of Spirometry

ANKANAHALLI RAMU SOMASHEKHAR[1], V NANCY JENIFFER[2], K SINDHU[3], DA CHIRAG[4], SMITHA R CHANDRA[5]

ABSTRACT

For financial sustainability and service-based efficiency in healthcare services, there is a need for better understanding and application of cost analysis, Break-even Point (BEP) analysis, and Cost-benefit Analysis (CBA). The present article focuses specifically on Paediatric spirometry and highlights literature and case-based evidence to show how BEP helps determine the minimum service volume required for cost recovery. Evaluating healthcare expenditures against medical benefits, pricing decisions, and investment planning is crucial from a healthcare administration perspective, and these objectives can be achieved through CBA. The present review emphasises the importance of structured financial planning to ensure high-quality, cost-effective healthcare services by integrating break-even and cost-benefit analyses.

Keywords: Cost-benefit analysis, Healthcare cost, Health priorities, Health resources, Health services accessibility

INTRODUCTION

The CBA in healthcare involves assessing the expenses associated with medical resources in comparison to the potential benefits. This evaluation is crucial for setting priorities, particularly when resources are limited. To maintain clarity in medical decision-making, CBA should be distinctly separated from risk-benefit analysis and assessments of efficiency [1].

Risk-benefit analysis involves weighing the likelihood of adverse effects against the potential positive outcomes of a medical intervention, and it plays an essential role in determining the necessity of treatments in delivering high-quality care [1,2]. Efficient medical care is defined as the timely delivery of essential services at minimal cost while adhering to established medical standards. In contrast, cost-effective medical care compares multiple intervention strategies using standardised cost and benefit measurements [3]. Decisions regarding reimbursement or coverage for medically necessary treatments often depend on contractual agreements between insurers, employers, healthcare plans, and government agencies [4].

Funding for Medical Equipment

Hospitals require a broad range of medical equipment, from relatively inexpensive items costing under ten thousand rupees to advanced, high-cost machines worth crores of rupees. Most hospitals receive funding for acquiring and maintaining medical equipment through various sources such as:

1. **Government allocations and grants:** Provided by agencies such as the Department of Health and Human Services, Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH), or historic programs like Hill-Burton for modernisation and infrastructure [3,5].
2. **Private foundation or research grants:** Offered by philanthropic bodies (e.g., Robert Wood Johnson Foundation) and corporations supporting medical and scientific innovation [4,5].
3. **Charitable and corporate sponsorships:** Funding through Corporate Social Responsibility (CSR) initiatives, in-kind or monetary donations, including hospital-specific charities like the Queen Elizabeth Hospital Birmingham (QEHB) Charity, that purchase specialised equipment [4,5].
4. **Internal revenue sources:** Funds generated from hospital operations, clinical service income, investment returns, licensing, and diversified activities [4].
5. **Research and innovation grants:** Grants earmarked for specialised or advanced research equipment, supported by private and educational institutions [3].
6. **Anonymous donations:** Contributions from individuals who choose to remain unnamed, typically earmarked for equipment acquisition (a common practice, though not widely documented) [5,6].

Annual equipment and infrastructure maintenance grants are largely based on patient volume and consist of:

1. The Capital Medical Equipment Program, which includes targeted equipment grants and special acquisitions;
2. Internal revenue sources, such as hospital surpluses, business unit income, and fundraising efforts;
3. Equipment management and long-term planning [6].

Effective decision-making regarding medical equipment requires a thorough assessment of maintenance costs versus replacement costs. Hospitals should adopt a long-term (e.g., five-year) strategy for planning their medical equipment needs.

This approach should include:

1. Regular monitoring of equipment lifespan and condition;
2. Developing strategies to address funding gaps and uncertainties;
3. Ensuring efficient asset management, as medical equipment is essential to patient care [6,7].

Hospitals manage a wide variety of equipment, ranging from relatively low-cost infusion pumps (under ₹5 lakh, ~6000 USD) to complex machines such as linear accelerators, which can cost crores of rupees and require substantial ongoing maintenance [8].

Asset Management Framework in Hospitals

A structured asset management framework is crucial to minimising risks associated with infrastructure investments and ensuring a systematic approach to asset replacement and management [9]. The key principles include:

1. Decisions should be based solely on healthcare service requirements.

2. Asset management should align with corporate strategies, budgets, and evaluation processes.
3. Choices should consider all available alternatives and lifecycle costs.
4. Management should align with broader government resource planning.
5. Clear guidelines should outline ownership, control, and reporting requirements.
6. Planning should explore alternatives to physical asset acquisition, such as demand-management strategies [9,10].

Factors Influencing Medical Equipment Lifespan

Medical equipment must eventually be replaced or upgraded, but several factors beyond age influence its longevity and usability. These include usage levels, quality of maintenance, technological advancement, evolving clinical practices, and the availability of spare parts [11].

In addition to CBA and effective asset management, BEP analysis plays a vital role in healthcare decision-making. For hospitals, BEP analysis is particularly relevant in the procurement and maintenance of high-cost medical equipment. Understanding when such investments become financially viable is crucial, especially for technologies requiring significant capital investment, such as linear accelerators and infusion pumps [12].

Application of BEP Analysis in Healthcare

1. **Medical equipment investments:** Hospitals must determine the number of procedures or treatments required using newly acquired equipment to recover the initial cost and subsequent maintenance expenses. For example, if a hospital purchases an MRI machine costing three crore rupees, BEP analysis can determine the number of scans needed to justify the investment [6,13].
2. **Cost-effectiveness of treatments:** BEP analysis helps assess the feasibility of introducing new medical interventions or treatments. It assists in determining whether insurance coverage and patient payments adequately compensate for administrative, medication, and other associated costs [12].
3. **Hospital resource allocation:** BEP analysis enables hospitals to allocate their limited funds towards infrastructure and high-cost equipment based on the revenue these assets can generate, while also considering patient outcomes [11].
4. **Public vs private healthcare funding:** Government-funded hospitals that operate with constrained budgets can use BEP analysis to determine whether medical procedures are feasible within budgetary limits and still deliver essential services. Private hospitals, on the other hand, can use the analysis to balance operational costs with potential revenue [11].
5. **Long-term financial planning:** Integrating BEP analysis into asset management frameworks helps hospitals create sustainable financial models, reducing dependence on unpredictable funding sources and ensuring continued access to medical services for patients [11,12].

By integrating BEP analysis with cost-benefit evaluation and strategic asset management, healthcare institutions can optimise resources, improve financial sustainability, and enhance overall service delivery [13].

Break-even analysis is a straightforward mathematical approach used to identify the point at which revenue equals total costs, resulting in neither profit nor loss. This threshold, known as the BEP, represents the minimum level of financial sustainability once pricing and profit margins are established [13,14].

Also referred to as cost–volume–profit analysis, break-even analysis is a crucial tool for examining the relationship between costs, revenue, and profitability. Simple graphical methods can be applied in basic cases, whereas analytical techniques are used for more complex scenarios, including spreadsheet-based computations. Mathematically, the BEP is defined as the point where:

Total Costs=Net Revenue [12,15].

Net revenue, or "gross revenue" before adjustments, is calculated as sales revenue minus returns, discounts, or allowances [15].

In this article, the following timeline and exchange rates were used for cost estimations. Cost data were collected from January to June 2024. At that time, the exchange rate was 1 USD=82 INR. All costs are presented in both Indian Rupees (INR) and equivalent USD values for international comparison.

The estimates pertain to a tertiary care teaching hospital in Bengaluru, Karnataka, India. This referral centre caters to both urban and rural populations; however, as a private institution, its costs may be two to three times higher than those in government facilities.

Case Study

In a Paediatric clinic offering allergy testing for children, each test is priced at ₹5,000 (~60 USD), while the variable cost per test amounts to ₹2,000 (~24 USD). Thus, the contribution per unit price is:

₹5000-₹2000=₹3000 (~36USD)

Assuming annual fixed costs of ₹15,00,000 (~18,100 USD)—including rent, salaries, and equipment maintenance—the clinic must conduct a minimum of 500 allergy tests annually to break even.

BEP (units)=Fixed Costs/Contribution per Unit [11]=₹15,00,000/₹3,000=500 tests.

Understanding Fixed and Variable Costs

For break-even analysis, costs are categorised into fixed and variable components. Fixed costs, such as rent and insurance, remain unchanged regardless of service volume. In contrast, variable costs fluctuate based on service output, directly correlating with the number of procedures performed [15,16].

Variable cost refers to expenses that vary directly with service output, such as the number of procedures or patients, disposable medical supplies, the number of tests performed, or wages of temporary staff [16].

Assuming fixed and variable costs remain constant within a given output range, break-even service volume can be calculated using the previously stated equation. For the hospital to move closer to breaking even with each additional service, the selling price must exceed the variable cost per unit. Once the fixed costs are fully covered, any additional service beyond the BEP generates a financial surplus [17].

Most hospitals and clinics deliver multiple services. While some fixed costs can be directly assigned to specific services—thus allowing calculation of each service's BEP—certain expenses such as facility rent and senior management salaries are shared across services and cannot be individually allocated [18]. To determine the overall BEP of the organisation, the following steps are required:

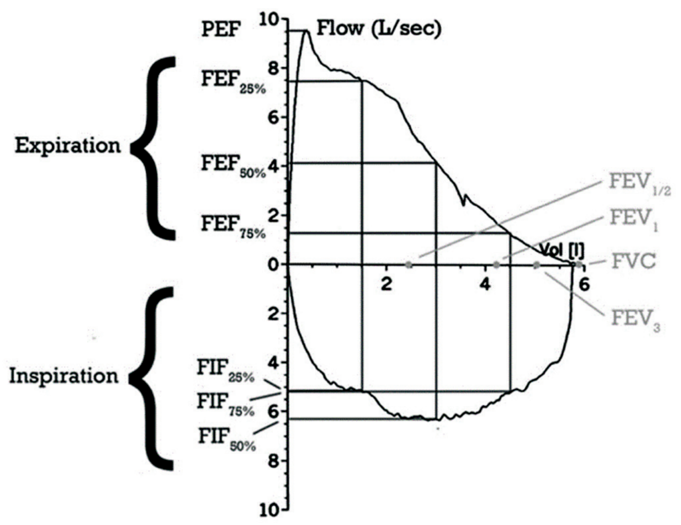
- Aggregating all fixed costs into a single total
- Identifying an alternative measure for contribution per unit, since calculating it based on just one service may not accurately reflect overall performance

In such cases, calculating a weighted average contribution per unit provides a more accurate representation, although it requires additional computation.

Now, let us apply these principles to spirometry and calculate its BEP.

Spirometry, the measurement of breath, is the most widely used Pulmonary Function Test (PFT). It measures lung function—specifically the volume and/or flow rate of air used for inhalation and exhalation. Spirometry is an important tool for generating pneumotachographs, which help assess conditions such as asthma, pulmonary fibrosis, cystic fibrosis, and Chronic Obstructive Pulmonary Disease (COPD). It is also a valuable monitoring tool, as a sudden decline in Forced Expiration Volume $(FEV)_1$ or other spirometric parameters may indicate worsening disease control, even when absolute values remain within the normal range. Patients are encouraged to track their personal best readings for comparison [19].

The flow–volume loop curve of spirometry, where positive values represent expiration and negative values denote inspiration has been depicted in [Table/Fig-1].



[Table/Fig-1]: Flow-volume loop showing successful Forced Vital Capacity (FVC) maneuver.
PEF: Peak expiratory flow; FIF: Forced inspiratory flow

X-axis: Volume (litres); Y-axis: Flow rate (L/sec).

At the start of the test, both flow and volume are at zero, representing the reading recorded by the spirometer rather than actual lung volume. After initiation, the peaking curve corresponds to the Peak Expiratory Flow (PEF).

Considerations and Limitations of Spirometry

- Accuracy of spirometry depends on patient effort and cooperation, requiring a minimum of three attempts for reproducibility.
- Forced Vital Capacity (FVC) can be underestimated but not overestimated.
- Spirometry is suitable only for children aged six years and older who can follow instructions.
- Patients who are unconscious, sedated, or who have cognitive or physical limitations preventing forceful breathing cannot undergo the test.
- Alternative lung function tests are available for infants and non-responsive patients.
- In mild or intermittent asthma, the diagnostic value of spirometry may be limited because results can be normal between episodes [20].

Spirometers [21] are available in a wide range of models, including:

- Basic handheld spirometers
- Advanced spirometers
- Modern electronic spirometers
- New-generation spirometers with built-in printers and computer connectivity
- It is recommended to choose a spirometer that complies with American Thoracic Society (ATS) and European Respiratory Society (ERS) standards [21].

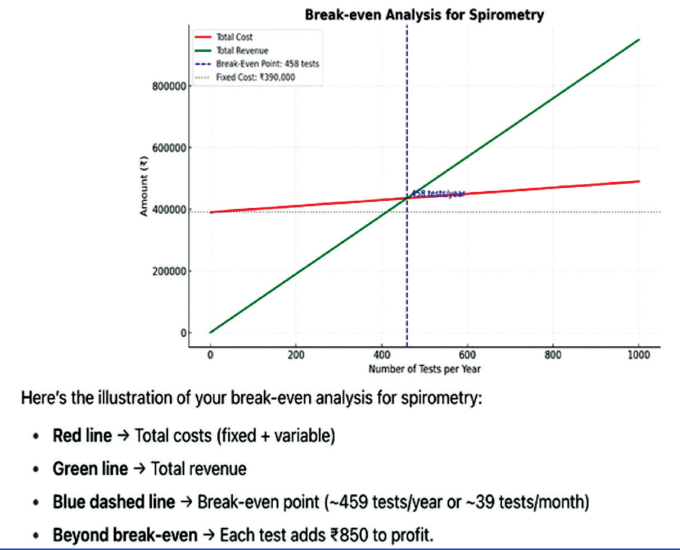
Spirometry requires proper training to perform accurately. To maintain proficiency, it is recommended that a technician or physician conduct at least five tests per week (20 per month) after completing initial competency training [21].

Calculating Break-even Analysis for Spirometry [Table/Fig-2,3]

As shown below, authors have calculated the BEP for the Smart Power Fault Tolerant (PFT) Universal Serial Bus (USB) spirometer by Medical Equipment Europe GmbH, purchased in February 2024 for use in a tertiary care centre.

Parameters	Cost (INR)	Cost (USD)
Machine **(Smart PFT USB)**	3,00,000	3,600
Annual maintenance	30,000	360
Technician salary share	60,000	720
Total fixed cost	3,90,000	4,700
Variable costs per test	100	1.21
Revenue per test	950	11.5
BEP tests/year	459	459

[Table/Fig-2]: BEP for the Smart PFT USB spirometer.



[Table/Fig-3]: Break-even analysis.

Using the break-even formula:

$$\text{Break-even volume} = \frac{\text{Fixed Cost}}{\text{Revenue per test - Variable cost per test}}$$

$$= \frac{3{,}90{,}000}{950-100}$$

=459 tests per year

Interpretation:

- The facility must perform at least 459 spirometry tests per year (approximately 39 tests per month) to cover fixed and variable costs.
- Beyond 459 tests per year, each additional test generates a profit of ₹850 (~10.4 USD).
- Strategies to reduce the BEP include lowering fixed costs, optimising consumables, and increasing patient volume [18].

Case study 1 - Government hospital: At PGIMER Chandigarh, the establishment of a Pulmonary Function Test (PFT) laboratory allowed the Institution to offer spirometry services at a cost-effective rate of approximately ₹600 per test. To maintain optimal patient throughput and ensure service sustainability, a centralised referral system was implemented, directing patients from various departments to the PFT laboratory.

This affordability was achieved through efficient resource utilisation and lower fixed costs compared to private facilities.

The present case highlights the importance of strategic planning and resource allocation in achieving financial sustainability in government healthcare settings [22].

Case study 2 - Rural clinic: In a rural clinic setting, limited patient volume posed challenges in achieving the BEP for PFT services. To address this, the clinic collaborated with nearby healthcare centres, pooling resources and sharing patient referrals. This network-based approach increased patient throughput, thereby improving the financial viability of the service.

Such collaborative models demonstrate the potential of inter-institutional partnerships in overcoming resource limitations and achieving sustainability in rural healthcare settings [23].

Case study 3- Private hospital: At Apollo Hospitals, Bengaluru, the high fixed costs associated with a Paediatric spirometry suite (~₹3,00,000) were offset by insurance reimbursements and higher patient throughput, enabling faster cost recovery [24].

Strategies for Healthcare Facilities Struggling to Meet the Required Spirometry Volume

Healthcare facilities that find it difficult to conduct the required number of spirometry tests can consider the following strategies:

1. **Reduce fixed costs:** Lower equipment maintenance contract expenses or optimise rental space utilisation.
2. **Reduce variable costs:** Source more cost-effective disposable filters, mouthpieces, or calibration gases while ensuring quality standards.
3. **Increase test volume:** Enhance patient awareness, collaborate with other departments for referrals, and promote preventive lung health screenings [21,25].

Any of these strategies can reduce the BEP, meaning the hospital will need to perform fewer spirometry tests to cover its fixed costs [26]. Once a facility surpasses the BEP, every additional test contributes directly to the profit (Target Income Sales) [27].

Several studies on break-even analysis have contributed valuable insights in this domain. Khurshid R et al., conducted a prospective six-month analysis at a tertiary care teaching hospital to determine the break-even volume for MRI scans. The BEP was calculated to be 2,481.4 scans, requiring a monthly utilisation of 413.5 scans. However, only 1,282 scans were performed during the study period (average 213.4 per month), indicating underutilisation [28].

Jyani G et al., examined the impact of insurance schemes on the financial viability of private hospitals. The study focused on break-even thresholds by forecasting the financial trajectory of hospitals, highlighting challenges in achieving profitability [29].

Chakravarty A emphasised the importance of ensuring the financial viability of technological advancements for cost-effectiveness and elaborated on break-even analysis concepts [30].

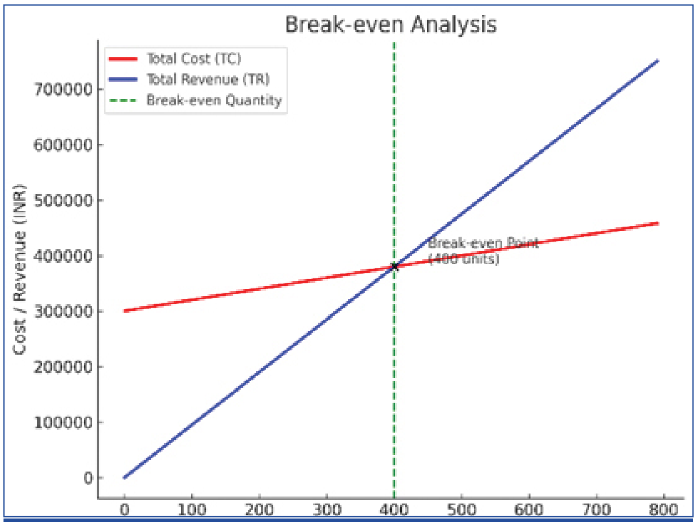
Agrawal N et al., provided insights into the financial sustainability of specialised medical services such as gamma knife surgery [31].

Importance of Break-even Analysis

1. Helps determine the minimum number of tests required to cover expenses.

Depending on costs and pricing strategies, different healthcare facilities may have varying BEPs. To achieve profits, a facility must increase service volume to cover both fixed and variable costs. In the case of spirometry, increasing the annual number of tests improves cost-effectiveness, as shown in [Table/Fig-4].

2. Supports planning and cost control
3. Assists in equipment acquisition decisions
4. Clarifies the cost-volume-profit relationship



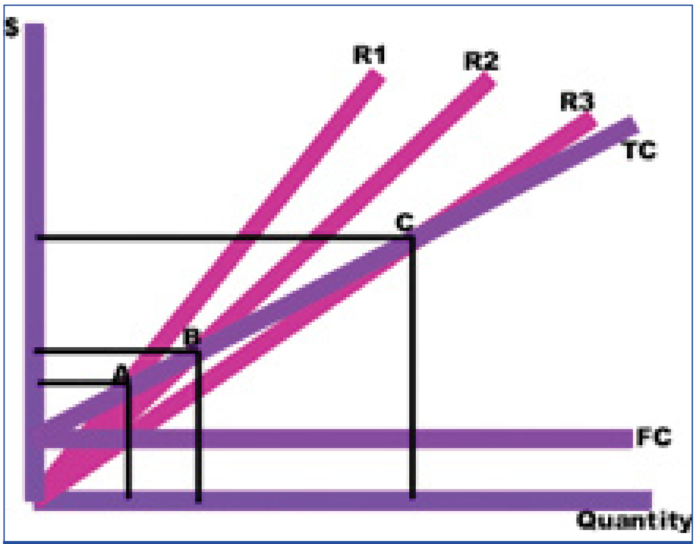
[Table/Fig-4]: Break-even Point (BEP) spirometry.

5. Enables profit estimation
6. Facilitates scenario analysis
7. Integrates with budgeting processes
8. Identifies minimum required business activity [31-33]

Break-even Analysis and Graphical Representation in Spirometry

To visualise break-even analysis results across different pricing levels, a graph can be used [Table/Fig-5]. This involves plotting the following:

1. **Total Cost Curve (TC):** Represents total costs at each testing volume.
2. **Fixed Cost Curve (FC):** Shows costs that remain unchanged regardless of the number of tests performed.
3. **Total Revenue Curves (R1, R2, R3):** Represent total revenue at different pricing levels.



[Table/Fig-5]: Break-even Point (BEP) for different revenues.

The BEPs (A, B, C) are the points where the total cost curve (TC) intersects the total revenue curves (R1, R2, or R3). The break-even quantity at different pricing levels can be interpreted from the horizontal axis, while the corresponding price can be read from the vertical axis.

The following equations, based on historical accounting data or estimation techniques, can be used to determine the total cost, total revenue, and fixed cost curves:

- **Total Revenue (TR)=Selling Price × Quantity**
- **Total Cost (TC)=Fixed Cost+(Variable Cost×Quantity)**

Margin of Safety and Sensitivity Analysis

- **Margin of Safety (MOS):** The difference between the current test volume and the BEP. A higher MOS indicates greater financial stability.
- **Sensitivity analysis:** Modifies the BEP by adjusting key factors such as equipment costs, consumable expenses, salaries, and patient volume.
    - Higher variable costs → more tests required to break even
    - Higher revenue or patient volume → BEP decreases [34,35]

Systematic review evidence: Studies show that incorporating sensitivity analysis enhances decision-making for diagnostic equipment procurement in both public and private hospitals [35]. Sensitivity analysis evaluates how changes in key variables affect the BEP, helping healthcare administrators assess financial sustainability under different scenarios [35,36].

By modifying factors such as equipment maintenance costs, technician salaries, consumable prices, or insurance reimbursements, hospitals can anticipate potential risks and create contingency plans. An increase in variable cost per test requires more tests to cover expenses. Conversely, higher reimbursement rates or increased patient volume can improve financial viability by lowering the BEP.

Thus, integrating sensitivity analysis into break-even calculations enables hospitals to:

- Make data-driven decisions
- Optimise pricing strategies
- Ensure long-term financial sustainability

Equipment upgrades: A new machine or increased rental costs raise fixed expenses, requiring more tests to break even. Reduced fixed costs: Through extended depreciation, grants, or leasing, fewer tests are needed to cover expenses. Sensitivity analysis also helps identify financial risks arising from rising costs or declining revenue. Government healthcare schemes such as NHM and Ayushman Bharat can reduce financial burden [35,36].

Limitation(s)

- Applicable to only one service at a time
- Difficulty in classifying costs (not always clearly variable or fixed)
- Assumption of constant costs (fixed costs may vary with scale)
- Does not consider market demand
- Assumes a constant sales mix
- Assumes no inventory changes
- Ignores efficiency gains or technological advancements

CONCLUSION(S)

Break-even analysis is a valuable financial tool for healthcare facilities offering spirometry services. It enables administrators to make informed decisions regarding pricing, cost management, and equipment acquisition. Although it has certain limitations, it remains an effective method for financial reporting and strategic planning. Integrating BEP with Cost-benefit Analysis (CBA) enhances resource allocation, supports strategic planning in both government and private hospitals and sensitivity analysis ensures financial sustainability across varying operational scenarios

REFERENCES

[1] Sinden A. Formality and informality in cost-benefit analysis. Utah Law Rev. 2015:93.
[2] Chalkidou K, Tunis S, Lopert R, Rochaix L, Sawicki PT, Nasser M, et al. Comparative effectiveness research and evidence-based health policy: Experience from four countries. Milbank Q. 2009;87:339-67.
[3] Thomas R, Chalkidou K. Cost–effectiveness analysis. In: Cylus J, Papanicolas I, Smith PC, editors. Health system efficiency: How to make measurement matter for policy and management [Internet]. Copenhagen (Denmark): European Observatory on Health Systems and Policies; 2016.
[4] Crowley R, Mathew S, Hilden D, Health and Public Policy Committee of the American College of Physicians. Modernizing the United States' public health infrastructure: A position paper From the American College of Physicians. Ann Intern Med. 2023;176 (8):1089-91.
[5] Blanchfield BB, Demehin AA, Cummings CT, Ferris TG, Meyer GS. The cost of quality: An academic health center's annual costs for its quality and patient safety infrastructure. Jt Comm J Qual Patient Saf. 2018;44(10):583-89.
[6] Atwood D, Larose P, Uttley R. Strategies for success in purchasing medical technology. Biomed Instrum Technol. 2015;49 (2):93-98.
[7] Michaelides PG. Break-even point. In: Michaelides PG. 21 Equations that Shaped the World Economy: Understanding The Theory Behind The Equations. Cham: Springer Nature Switzerland; 2025. p. 103-12.
[8] Carlone M, Beckham W, Duzenli C, Kohli K, Tyldesley S. Linear accelerator maintenance cost analysis. J Appl Clin Med Phys. 2024;25(2):e14246. Doi: 10.1002/acm2.14246. Epub 2023 Dec 22. PMID: 38134322; PMCID: PMC10860406.
[9] Abuzayan KMA, Whyte A, Bell J. Asset-management framework(s) for infrastructure facilities in adverse (post-conflict/disaster-zone/high-alert) conditions. Procedia Economics and Finance. 2014;18:304-11. Doi: 10.1016/S2212-5671(14)00944-7.
[10] Kopanyi M, editor. Municipal finances: A handbook for local governments. Washington (DC): World Bank Group; p. 142-214.
[11] Ziefle M, Schaar AK. Technology acceptance by patients: Empowerment and Stigma. In: Mukhopadhyay SC, Postolache OA, editors. Handbook of Smart Homes, Health Care and Well-Being. Cham: Springer; 2014. p. 1-10.
[12] Maloney S, Haas R, Keating JL, Molloy E, Jolly B, Sims J, et al. Breakeven, cost benefit, cost effectiveness, and willingness to pay for web-based versus face-to-face education delivery for health professionals. J Med Internet Res. 2012;14(2):e47. Doi: 10.2196/jmir.2040. PMID: 22469659; PMCID: PMC3376523.
[13] Jakupi SZ, Statovci B, Hajrizi B. Break-even analysis as a powerful tool in decision-making. Int J Manag Excell. 2017;9(3):1169-71.
[14] Gubio Z, Mustapha LO, Agbi SE. The effect of break-even-point analysis in decision making in some selected block industries within Kaduna metropolis. Quest J Res Bus Manag. 2022;10:22-32.
[15] Utami Y, Mubarok A. Determining products or services pricing on MSME using break-even point analysis method. Int J Econ Bus Account Res. 2021;5(2).
[16] Clemens J, Gottlieb JD. Do physicians' financial incentives affect medical treatment and patient health? Am Econ Rev. 2014;104(4):1320-49.
[17] Sintha L. Importance of break-even analysis for the micro, small and medium enterprises. Int J Res Granthaalayah. 2020;8(6):212-18.
[18] Soufi M. Locating problems for medical centers and emergency services. In: Soufi M, editor. Decision making in healthcare systems. Singapore: Springer; 2023 Dec 31. p. 173-88.
[19] Khumukcham N, Romita Potsangbam RR, Wilubuibou P. Assessment of autonomic function using heart rate variability among mild and moderate chronic obstructive pulmonary disease: A cross-sectional study. Int J Acad Med Pharm. 2025;7(4):1282-87.
[20] Lopes AJ. Advances in spirometry testing for lung function analysis. Expert Rev Respir Med. 2019;13 (6):559-69.
[21] Parsons R, Schembri D, Hancock K, Lonergan A, Barton C, Schermer T, et al. Effects of the Spirometry Learning Module on the knowledge, confidence, and experience of spirometry operators. NPJ Prim Care Respir Med. 2019;29(1):30. Doi: 10.1038/s41533-019-0143-9. PMID: 31399575; PMCID: PMC6689054.
[22] Gupta R, Sharma S, Kumar S. Financial viability of pulmonary function testing in a government hospital: A case study of PGIMER Chandigarh. Indian J Health Econ. 2023;35(2):45-50.
[23] Patel R, Mehta A, Joshi S. Collaborative models for achieving financial sustainability in rural healthcare: A case study of pulmonary function testing services. Rural Health India. 2024;12(1):22-28
[24] Manipal Hospital. Case Study at Manipal Hospital. Scribd; 2022 Mar 16. Available from: https://www.scribd.com/document/238646740/Case-Study-at-Manipal-Hospital.
[25] Ferguson GT, Enright PL, Buist AS, Higgins MW; National Lung Health Education Program. Office spirometry for lung-health assessment in adults: A consensus statement from the National Lung Health Education Program. Chest. 2000;117(4):1146-61. Doi: 10.1378/chest.117.4.1146.
[26] Khanna AK, Saager L, Bergese SD, Jungquist CR, Morimatsu H, Uezono S, et al. Opioid-induced respiratory depression increases hospital costs and length of stay in patients recovering on the general care floor. BMC Anesthesiol. 2021;21:172.
[27] Azadi M, Etaati Z, Raini SN, Nooraki A, Masjedi MR. Comparison of total cost of health services among asthmatic and COPD patients in uni-speciality hospital with general hospital. Tanaffos. 2006;5(3):45-49.
[28] Khurshid R, Tabish SA, Hakim A, Khan A, Singh Y. Break-even analysis of MRI facility at a large tertiary care teaching hospital of North India. Int J Med Allied Health Sci. 2014;2(2):220.
[29] Jyani G, Gedam P, Sharma S, Dixit J, Prinja S. Financial viability of private hospitals operating under India's National Health Insurance Scheme. Indian J Health Econ. 2025;45(1):34-42.
[30] Chakravarty A. Cost-effectiveness analysis for technology acquisition. J Health Manag. 2011;13(2):123-35.

[31] Agrawal N, Sharma N, Jamwal T, Singh K, Siddharth V. Optimizing costs and sustainability for gamma knife radiosurgery: A cost and breakeven analysis at India's largest neurosurgery centre. PLOS ONE. 2025;20(1):e0306159.
[32] Gantugs Y, Otgonbayar D, Otgonbaatar D, Tseden P, Chimedsuren O. Cost study of respiratory system diseases. Value Health. 2016;19(7):A607.
[33] Woolf SH, Johnson RE. The break-even point: When medical advances are less important than improving the fidelity with which they are delivered. In: Woolf SH, Aron L, editors. The wonder and the mystery. Boca Raton: CRC Press; 2022 Feb 16. p. 222-36.
[34] Johnson E, Pilat F, Qualls H, Colby E, Fisher K, Melcer N, et al. Supply chain risk mitigation for scientific facilities and tools. Washington (DC): US Department of Energy, Office of Science; 2022 May 1.
[35] Dailami A, Kardofa M, Saputra J. Analysis of breakeven point and margin of safety as a basis for profit planning at PT Unilever Indonesia Tbk in 2017–2021. International Journal of Global Operations Research. 2024;5(3):147-52. e-ISSN 2722-1016 | p-ISSN 2723-1739.
[36] Rivera M, Kizildag M, Croes R. COVID-19 and small lodging establishments: A break-even calibration analysis (CBA) model. Int J Hosp Manag. 2021;94:102814.

PARTICULARS OF CONTRIBUTORS:
1. Professor, Department of Paediatrics, Ramaiah Medical College and Hospital, Bengaluru, Karnataka, India.
2. Assistant Professor, Department of Paediatrics, Ramaiah Medical College and Hospital, Bengaluru, Karnataka, India.
3. Resident, Department of Paediatrics, Ramaiah Medical College and Hospital, Bengaluru, Karnataka, India.
4. Resident, Department of Paediatrics, Ramaiah Medical College and Hospital, Bengaluru, Karnataka, India.
5. Resident, Department of Hospital Administration, Ramaiah Medical College and Hospital, Bengaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Ankanahalli Ramu Somashekhar,
Professor, Department of Paediatrics, Ramaiah Medical College and Hospital,
Mathikere, Bengaluru-560054, Karnataka, India.
E-mail: s_arshekar2002@yahoo.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 01, 2025
- Manual Googling: Nov 14, 2025
- iThenticate Software: Nov 17, 2025 (7%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Mar 19, 2025**
Date of Peer Review: **May 29, 2025**
Date of Acceptance: **Nov 19, 2025**
Date of Publishing: **Feb 01, 2026**