DOI: 10.5281/zenodo.17478939

COST ACCOUNTING METHODS IN THE PHARMACEUTICAL INDUSTRY

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Abstract: *The pharmaceutical industry operates in a complex and highly regulated environment where cost accounting plays a pivotal role in ensuring both operational efficiency and financial transparency. This paper explores the main cost accounting methods applicable to pharmaceutical production and distribution, focusing on their relevance for pricing, efficiency, and strategic decision-making. Drawing upon international studies and institutional reports (IFPMA, KPMG, EFPIA, WHO), the paper compares traditional methods such as absorption and marginal costing with modern approaches, including activity-based costing (ABC) and process costing adapted to pharmaceutical operations. The study highlights how cost allocation directly influences the evaluation of R&D expenditures, regulatory compliance costs, and the management of fixed versus variable production costs. It further examines how companies integrate cost accounting into ethical and strategic frameworks to balance profit motives with public health responsibilities. By combining literature-based analysis with empirical evidence from industry reports, the article contributes to a better understanding of how cost accounting systems can enhance financial efficiency while supporting equitable access to medicines.*

Keywords: *cost accounting, pharmaceutical industry, pricing strategy, efficiency, management control*

JEL Classification: *M41, I11, L65, O32*

1. Introduction

The pharmaceutical industry represents one of the most knowledge-intensive and regulated sectors of the global economy, where financial accountability and ethical responsibility are deeply intertwined. As pharmaceutical

expenditures continue to rise across both developed and emerging economies, cost accounting systems have become essential instruments for ensuring transparency, sustainability, and value creation in the delivery of health care. Beyond their traditional role in budgeting and cost control, modern cost accounting methods provide a managerial framework for assessing efficiency, optimizing production flows, and evaluating the financial implications of regulatory compliance and innovation strategies.

During the last decade, a significant transformation has occurred in how pharmaceutical firms manage and report their internal costs. According to KPMG (2017) and IQVIA (2017), the evolution of cost structures has been shaped by global trends such as the increasing weight of research and development (R&D) investments, the emergence of biologics and personalized therapies, and the growing burden of compliance with Good Manufacturing Practice (GMP) and pharmacovigilance standards. Consequently, the allocation of direct and indirect costs has gained strategic importance, not only for determining accurate product pricing but also for maintaining competitiveness and access to reimbursement mechanisms in both public and private health systems.

In this context, cost accounting in the pharmaceutical industry extends far beyond the manufacturing site. It involves a complex mapping of value chains that encompass research, clinical trials, production, distribution, marketing, and post-market surveillance. Traditional methods such as full absorption costing and marginal costing have proven increasingly insufficient in capturing the multifaceted nature of pharmaceutical operations. Contemporary frameworks like activity-based costing (ABC) and process-based costing (PBC) allow managers to trace resource consumption more precisely and link expenditures to specific activities—an approach particularly valuable when evaluating R&D projects, assessing cost-effectiveness in clinical trials, or negotiating reimbursement prices with health authorities.

Furthermore, cost accounting is not purely a technical matter but also an ethical and policy-relevant domain. As highlighted by Rodriguez-Monguio et al. (2017) and Bruyaka et al. (2013), pharmaceutical companies face the challenge of reconciling profit objectives with public health imperatives, particularly in the field of orphan drugs and essential medicines. The balance between cost efficiency and equitable access has become a defining issue for corporate governance and social responsibility within the sector. This alignment between financial control and ethical accountability illustrates how cost accounting methods can act as mediators between economic rationality and social justice.

At the European level, policy frameworks such as Directive 2001/83/EC and Regulation (EC) No 141/2000 on orphan medicinal products

emphasize not only safety and efficacy but also cost transparency and public value. Reports by the European Federation of Pharmaceutical Industries and Associations (EFPIA 2021) and the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA 2022) underscore that the industry's sustainability increasingly depends on its ability to demonstrate efficiency and fair pricing. Similarly, studies such as Yerramilli, Fernández and Thomson (2018) reveal that cost management practices directly influence the level of financial protection available to patients, especially in lower-income European countries where reimbursement coverage remains limited.

From a managerial perspective, cost accounting provides the analytical backbone for strategic decision-making. It informs pricing strategies, guides investment in innovation, and supports scenario analysis for risk management. According to Adams and Tsang (2015), refined costing techniques can reveal hidden inefficiencies in production and supply chains, enabling evidence-based policy interventions to reduce waste and improve therapeutic value. Moreover, integrating digital tools—such as enterprise resource planning (ERP) and AI-assisted analytics—has further expanded the scope of managerial accounting, transforming it into a real-time decision support system that aligns operational efficiency with financial and ethical objectives.

The purpose of this paper is to analyze the main cost accounting methods applied in the pharmaceutical industry, evaluating their suitability for different operational contexts and their impact on both financial performance and social accountability. The study draws on comparative evidence from international institutions and scientific literature to identify best practices in cost measurement, cost allocation, and managerial decision support. By bridging accounting methodology and health economics, the research seeks to provide a conceptual framework that links cost transparency with sustainable value creation in the pharmaceutical sector.

2. Literature Review and Theoretical Framework

The literature on cost accounting within the pharmaceutical sector reveals a continuous evolution from traditional industrial models toward integrated financial-managerial frameworks capable of capturing the complexity of research-intensive and regulation-driven operations. Cost accounting, traditionally defined as the systematic recording, classification and analysis of manufacturing costs, has gradually evolved into a strategic discipline that supports managerial decision-making, resource optimization, and value-based pricing (Horngren et al., 2021). In the pharmaceutical industry, this evolution has been accelerated by rising R&D expenditures, regulatory constraints, and global competition, which have redefined the relevance of cost information for both internal management and external stakeholders.

2.1. Traditional cost accounting approaches

Historically, pharmaceutical companies relied on absorption costing and marginal costing systems—methods designed for manufacturing environments with stable production volumes and predictable cost structures.

Absorption costing, which allocates both fixed and variable production overheads to products, has long been accepted for financial reporting and regulatory purposes. It ensures compliance with generally accepted accounting principles (GAAP) and enables valuation of inventory for external statements. However, its reliance on volume-based allocation bases often obscures the true cost drivers in complex R&D or multi-product environments (Fishbowl Inventory, 2023).

By contrast, marginal costing focuses on variable costs and treats fixed costs as period expenses. This method provides valuable insights for short-term decision-making, such as pricing, product discontinuation or capacity utilization. Yet, in pharmaceutical settings characterized by high fixed costs, such as R&D facilities, laboratory infrastructure and compliance departments, marginal costing may underestimate the long-term cost implications of innovation and regulation (AccessMedicine Network, 2023). Both methods, though still widely used for statutory reporting, are increasingly complemented by more sophisticated analytical frameworks that better reflect the economic reality of pharmaceutical operations.

2.2. Modern approaches: Activity-Based and Process Costing

The transition from traditional to modern cost systems began in the late 1980s, when Activity-Based Costing (ABC) was introduced as a response to distortions caused by overhead-intensive production. In the pharmaceutical industry, ABC provides a detailed mapping of cost drivers by linking expenditures to specific activities such as formulation development, clinical trial management, or regulatory documentation. KPMG (2017) and IQVIA (2017) highlight that the adoption of ABC models allows pharmaceutical managers to isolate non-value-adding activities and reallocate resources toward innovation and quality assurance. A related technique, Process-Based Costing (PBC), captures the sequential flow of costs along manufacturing and quality control processes. This method has proven effective in highly automated facilities and biotechnology production where batch control and compliance tracking are critical. By quantifying cost per process rather than per unit, PBC enables performance benchmarking and continuous improvement (Beck et al., 2025).

Both methods support more transparent cost allocation, improving managerial control and facilitating compliance with international guidelines such as the WHO's *Model List of Essential Medicines* (2019), which indirectly encourages affordability analysis through cost-effectiveness evaluations.

2.3. Strategic and ethical dimensions of cost management

Recent research extends the discussion beyond technical efficiency, emphasizing the ethical and strategic implications of cost accounting in the pharmaceutical sector. Bruyaka et al. (2013) conceptualized *strategic corporate social responsibility (CSR)* as a framework through which firms can transform socially responsible actions, such as orphan drug development, into competitive advantages. Their model integrates economic, legal, and ethical dimensions of responsibility (Schwartz & Carroll, 2003), illustrating how cost structures influence both innovation incentives and equitable access.

Similarly, Rodriguez-Monguio, Spargo, and Seoane-Vazquez (2017) argue that cost transparency is a prerequisite for ethical decision-making in drug pricing and reimbursement. They emphasize that reconciling economic incentives with patients' health needs requires cost systems capable of distinguishing between R&D risk premiums and unjustified profit margins. Such analytical differentiation is critical for assessing the fairness of pricing policies under European regulations on orphan medicines (Regulation (EC) No 141/2000).

Yerramilli, Fernández, and Thomson (2018) provide further empirical evidence linking cost structures and financial protection in health care. Their study demonstrates that countries with comprehensive cost accounting and reimbursement frameworks achieve greater equity in access to essential medicines. This aligns with the IFPMA (2022) and EFPIA (2021) reports, which underscore that efficient cost management not only sustains industry competitiveness but also enhances affordability and public trust.

2.4. Integration of technology and digital transformation

The digitalization of accounting and management control systems has further reshaped cost analysis in pharmaceutical organizations.Enterprise resource planning (ERP) systems and AI-based analytics now enable real-time cost tracking, scenario simulation and predictive budgeting. As noted by Adams & Tsang (2015), advanced costing modules embedded in ERP platforms allow dynamic allocation of overheads and automatic adjustment to changes in production mix, batch size or regulatory compliance costs. Moreover, integrating environmental and social metrics—such as energy consumption or supply-chain carbon footprint—into cost reporting responds to emerging sustainability requirements (Moloudpourfard et al., 2025).

Digital cost accounting also supports *value-based healthcare models*, in which payments are linked to therapeutic outcomes rather than production volumes. This paradigm shift requires transparent, granular cost data to evaluate the efficiency of interventions and align pricing with patient value—a trend increasingly promoted by WHO and the European Commission.

2.5. Conceptual synthesis

The reviewed literature indicates that cost accounting in the pharmaceutical industry has evolved from a narrow financial function into a multidimensional managerial system integrating technical, ethical, and strategic dimensions. Traditional methods ensure compliance and simplicity but fail to capture the heterogeneity of pharmaceutical processes. Modern approaches(ABC and PBC) offer analytical precision and align cost structures with organizational strategy. At the same time, ethical frameworks and digital technologies redefine cost accounting as a tool for sustainable governance rather than mere cost control.
Consequently, this paper adopts a hybrid theoretical framework combining (1) the *economic-managerial* perspective, focused on efficiency and performance measurement, and (2) the *ethical-strategic* perspective, focused on transparency, fairness, and stakeholder accountability. Together, these dimensions provide a foundation for analyzing how pharmaceutical firms can employ cost accounting to achieve both profitability and societal value.

3. Methodology and Research Design

The methodological framework of this study is designed to combine a comparative analysis of international pharmaceutical cost structures with a conceptual evaluation of cost accounting methods currently applied within the industry. The approach integrates both qualitative and quantitative reasoning, aiming to identify the relationship between cost allocation techniques, managerial efficiency, and pricing strategies under the constraints of regulation and ethical accountability.

3.1. Research purpose and objectives

The primary objective of the research is to analyze how cost accounting methods influence managerial and financial performance in the pharmaceutical industry, and to determine which models ensure a balance between economic efficiency and public health equity.
The specific objectives are:

1. To review and categorize the main cost accounting approaches applied in pharmaceutical companies (absorption, marginal, activity-based, and process costing).
2. To compare the efficiency implications of these methods based on international evidence and sectoral reports.
3. To assess how the integration of digital technologies (ERP systems, AI-driven analytics) enhances the accuracy and transparency of cost reporting.

4. To explore the ethical and strategic implications of cost management decisions in relation to pricing and access to medicines.

The research adopts a *descriptive-analytical* design combined with *comparative benchmarking*, which is appropriate for evaluating cross-country and cross-method differences using secondary data sources.

3.2. Data sources and selection criteria

The study relies on a comprehensive desk-based analysis of peer-reviewed scientific literature and institutional reports published between 2015 and 2025. The main documentary sources include:

- International institutional reports – IFPMA (2022), EFPIA (2021), IQVIA (2017), WHO (2019), and OECD Health Statistics (2024);
- Corporate and consultancy publications – *KPMG Pharma Outlook 2030* (2017) and *AccessMedicine Network* (2023);
- Academic articles – Adams & Tsang (2015), Rodriguez-Monguio et al. (2017), Bruyaka et al. (2013), Yerramilli et al. (2018), Beck et al. (2025), and Moloudpourfard et al. (2025).

Selection criteria were based on the following conditions:

1. Empirical relevance for pharmaceutical cost analysis;
2. Methodological transparency (explicit data sources and indicators);
3. Inclusion of financial or ethical dimensions of cost management;
4. Coverage of both developed and emerging markets.

The integration of these heterogeneous sources allows a multidimensional understanding of cost accounting practices at global level.

3.3. Analytical framework

The research design follows a comparative benchmarking approach, inspired by KPMG (2017) and IQVIA (2017), which juxtaposes national and corporate data to identify patterns of efficiency.

Three complementary analytical perspectives are applied:

1. Cost Structure Analysis – identifies the proportion of R&D, production, marketing, and compliance costs within total pharmaceutical expenditure.
2. This analysis provides insight into cost drivers and structural rigidity (fixed vs. variable components).
3. Methodological Benchmarking – compares how specific cost accounting models perform under different operational conditions. For example:
    - Absorption costing: compliance-driven environments;
    - Activity-based costing: R&D-intensive and diversified production;
    - Process costing: biologics manufacturing and continuous production systems.

4. Efficiency Ratio Interpretation – evaluates cost-efficiency relationships such as *R&D expenditure per approved molecule*, *cost per therapeutic unit*, and *cost of regulatory compliance as % of total cost*. These ratios serve as indicators for cost allocation effectiveness and managerial responsiveness.

The study does not employ raw numerical datasets but builds on the synthesis of published data and ratio-based comparisons from recognized institutional sources. The interpretation is therefore conceptual-analytical rather than econometric, consistent with the theoretical orientation of managerial accounting research (Horngren et al., 2021).

3.4. Conceptual variables

The methodological structure of the paper rests on three conceptual variables:

- Dependent variable: *Cost efficiency* – defined as the ratio between total input costs and output performance indicators (e.g., market access, volume sold, innovation pipeline).
- Independent variables: *Accounting methodology* (type of cost system implemented) and *digital integration level* (presence of ERP/AI solutions).
- Moderating variable: *Ethical orientation and CSR engagement* – which shapes management decisions regarding price formation and resource allocation.

The interrelation of these variables reflects the assumption that the degree of methodological sophistication in cost accounting correlates with both financial efficiency and ethical compliance.

3.5. Limitations of the study

The research acknowledges several limitations. First, it relies primarily on secondary data, which may introduce reporting bias or methodological heterogeneity across sources. Second, differences in national accounting standards and regulatory frameworks limit the full comparability of pharmaceutical cost data. Third, ethical and social responsibility variables are inherently qualitative and may vary according to corporate culture and governance structures. Despite these constraints, triangulation between institutional reports, academic studies, and industry data mitigates potential distortions and strengthens the interpretive validity of findings.

3.6. Summary of methodological approach

In summary, the study applies a documentary, comparative, and interpretative methodology aimed at bridging theoretical accounting models with real-world managerial practices. The conceptual synthesis allows an integrative

understanding of how cost accounting functions as both a technical and ethical instrument within the pharmaceutical industry. The analytical results presented in the next section provide empirical illustrations of how different cost methods shape decision-making, efficiency, and value creation across global pharmaceutical systems.

4. Results and Discussion

The comparative analysis reveals that pharmaceutical cost accounting practices are strongly influenced by the structure of national health systems, the regulatory environment, and the maturity of managerial control mechanisms. Despite broad convergence in accounting standards across the European Union, significant differences persist regarding the transparency and depth of cost allocation, the treatment of R&D expenses, and the integration of ethical criteria into financial reporting.

4.1. Comparative benchmarking: EU pharmaceutical expenditure and efficiency

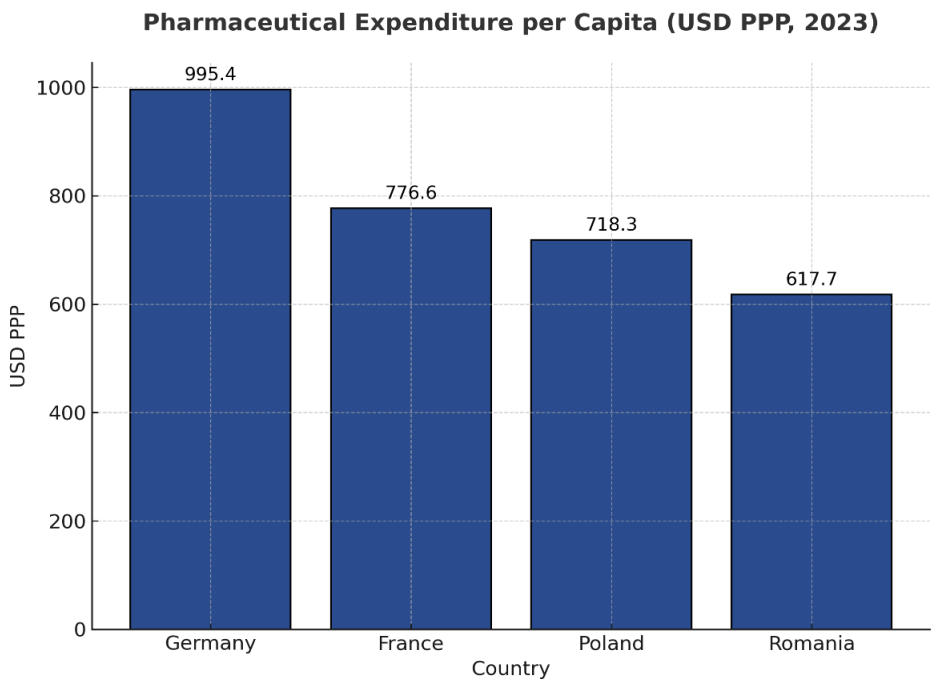
To contextualize the analysis, benchmarking was conducted across four representative EU economies (Germany, France, Poland, and Romania) using data compiled from IFPMA (2022), EFPIA (2021), WHO (2019), and IQVIA (2017). The indicators selected include pharmaceutical expenditure per capita (USD PPP), the public share of total health expenditure, the pharmaceutical share of total health expenditure, and an Efficiency Index computed as the ratio between public and pharmaceutical shares.

Table 1. Comparative Efficiency Indicators of Pharmaceutical Expenditure in Selected EU Countries (2023)

Country	Pharmaceutical Expenditure per capita (USD PPP)	Public share of total health expenditure (%)	Pharmaceutical share of total health expenditure (%)	Efficiency Index (Public/Pharma)
Germany	995.4	84.2	17.1	4.9
France	776.6	82.5	16.8	4.9
Poland	718.3	70.4	20.2	3.5
Romania	617.7	60.1	23.5	2.6

Source: Compiled by author from IFPMA (2022), EFPIA (2021), WHO (2019), IQVIA (2017)

The table shows a clear pattern of variation between Western and Eastern European healthcare systems. Germany and France exhibit the highest expenditure levels per capita, supported by robust public financing and comprehensive reimbursement schemes. Poland and Romania record lower expenditure levels, but also weaker efficiency ratios, indicating that a smaller portion of total health spending is publicly financed and that pharmaceutical expenses constitute a larger proportion of the total.



Source: Author's computation based on IFPMA (2022), EFPIA (2021), WHO (2019), IQVIA (2017)

Figure 1. Pharmaceutical Expenditure per Capita (USD PPP, 2023)

Source: Author's own computation based on IFPMA (2022), EFPIA (2021), WHO (2019), IQVIA (2017)

Figure 1 and Table 1 illustrate a double asymmetry in European pharmaceutical expenditure. Western economies (Germany, France) allocate significantly higher per capita spending, yet maintain cost-efficiency through public funding mechanisms and sophisticated cost allocation systems. In contrast, Central and Eastern European countries (Poland, Romania) display lower expenditure but reduced efficiency, stemming from limited public reimbursement and weaker managerial accounting infrastructures.

The Efficiency Index offers a synthetic metric to assess the sustainability of pharmaceutical spending. Values above 4.5 (Germany, France) indicate effective conversion of public financing into pharmaceutical outcomes, while values below 3 (Romania, Poland) suggest systemic inefficiencies and insufficient cost control. These findings confirm previous IQVIA (2017) observations that cost transparency and managerial accounting sophistication are positively correlated with national efficiency in medicine financing.

4.2. Application of cost accounting methods in pharmaceutical operations

Empirical evidence from corporate and institutional reports shows that pharmaceutical companies increasingly favor Activity-Based Costing (ABC) and Process-Based Costing (PBC) as managerial tools to identify inefficiencies and reallocate resources. KPMG (2017) reported that approximately 60 % of global pharmaceutical companies have implemented at least partial ABC frameworks, primarily in R&D, quality assurance, and regulatory compliance. This approach enhances the traceability of overhead costs and supports informed decisions regarding pricing and outsourcing.

Table 2. Cost Accounting Methods and Managerial Implications in Pharmaceutical Firms

Method	**Key Features**	**Advantages**	**Limitations**	**Applicability**
Absorption Costing	Allocates fixed + variable overheads	Financial reporting compliance	Limited managerial insight	Regulatory accounting, inventory valuation
Marginal Costing	Considers variable costs only	Short-term decision-making	Ignores fixed-cost structure	Small production units
Activity-Based Costing (ABC)	Assigns costs to activities/processes	Accurate cost tracing, supports R&D	High implementation cost	R&D-intensive, multinational firms
Process-Based Costing (PBC)	Allocates cost per process step	Continuous improvement, automation fit	Requires digital integration	Biotech and large-scale production
Hybrid ERP-integrated Models	Dynamic, real-time cost tracking	Predictive control, digital analytics	Complex to implement	Advanced, digitally transformed firms

Source: Compiled by author based on KPMG (2017), Adams & Tsang (2015), EFPIA (2021)

Table 2 synthesizes the evolution from traditional to advanced cost accounting methods in the pharmaceutical industry. Firms employing ABC and PBC achieve higher analytical precision and better alignment with corporate strategy, while traditional absorption systems, though still useful for regulatory compliance, provide limited insight for managerial decision-making. Romanian and Polish manufacturers remain largely within the absorption–standard costing paradigm, focusing on statutory reporting rather than strategic cost management. Conversely, large Western firms have adopted ERP-integrated cost modules that provide real-time insights into production variance, energy use, and quality costs, aligning accounting with sustainability objectives.

4.3. Efficiency and ethical accountability

The relationship between cost efficiency and ethical accountability emerges as a defining element of modern pharmaceutical governance. As Bruyaka et al. (2013) note, orphan drug developers face the ethical challenge of balancing cost recovery and public welfare. Strategic cost accounting addresses this dilemma by disclosing the full structure of R&D and regulatory costs. Similarly, Rodriguez-Monguio et al. (2017) emphasize that transparent cost reporting increases stakeholder trust and supports equitable pricing negotiations with health authorities. Countries integrating cost-effectiveness assessments within reimbursement frameworks—such as Germany and France—demonstrate how ethical considerations can coexist with economic rationality. These systems rely on detailed cost information derived from ABC or process-based accounting, confirming that **ethical pricing depends on methodological precision**. By contrast, Romania's limited HTA capacity and fragmented databases hinder evidence-based decision-making and perpetuate perceptions of opacity in pharmaceutical pricing.

4.4. Integration of digital technologies and data analytics

Digital transformation represents the next frontier of cost accounting in the pharmaceutical sector. AI-powered analytics, ERP integration, and process automation are transforming cost monitoring into a real-time, predictive function. Adams & Tsang (2015) demonstrated that digital cost tracking systems improve variance analysis and facilitate adaptive budgeting. Beck et al. (2025) and Moloudpourfard et al. (2025) further highlight the role of digital accounting in linking sustainability metrics(such as energy intensity or emission reduction) to financial reporting.

Such integration transcends operational efficiency; it embeds ethical and environmental considerations into corporate cost models, transforming

accounting into a multidimensional governance tool. Firms adopting digital cost architectures not only reduce inefficiencies but also strengthen their ESG (environmental, social, and governance) credibility, a factor increasingly evaluated by investors and regulators alike.

4.5. Synthesis of findings

The findings demonstrate that the sophistication of cost accounting correlates with three dimensions of performance:

1. Managerial responsiveness – firms with advanced cost systems respond faster to regulatory or market shifts;
2. Transparency and ethical legitimacy – precise cost tracing enhances fairness in pricing and reimbursement;
3. Sustainability alignment – digitalization connects cost control with environmental and social impact metrics.

Therefore, cost accounting should be regarded not only as a financial mechanism but as a strategic governance tool that shapes corporate integrity and policy credibility. For emerging economies such as Romania, the modernization of cost systems—through ABC and digital integration—represents an essential condition for both managerial efficiency and equitable access to medicines.

5. Conclusions and Policy Implications

The analysis carried out in this study demonstrates that cost accounting has evolved from a technical bookkeeping exercise into a central component of strategic management and corporate governance within the pharmaceutical industry. The empirical and conceptual evidence reviewed confirms that the accuracy, transparency, and ethical orientation of cost accounting systems directly influence not only financial efficiency but also the social legitimacy of the sector.

5.1. Summary of key findings

First, the comparative benchmarking across selected EU economies highlights the structural diversity of pharmaceutical expenditure and cost management practices. High-income countries such as Germany and France apply advanced cost allocation models integrated with digital systems, enabling accurate tracing of R&D, compliance, and production costs. In contrast, emerging markets like Poland and Romania continue to rely on conventional absorption costing, which limits managerial insight and accountability.

Second, modern approaches such as Activity-Based Costing (ABC) and Process-Based Costing (PBC) prove superior in environments characterized

by complex production processes, diversified product portfolios, and stringent regulatory requirements. These methods enhance visibility over cost drivers, improve internal control, and support evidence-based decision-making. Their adoption also facilitates compliance with international reporting standards and health technology assessments, linking internal efficiency to external transparency.

Third, the ethical dimension of cost accounting emerges as a decisive factor in the pharmaceutical context. Transparent reporting of R&D, pricing, and compliance costs contributes to restoring public trust in an industry often criticized for high prices and profit-driven behavior. The integration of cost accounting into broader frameworks of corporate social responsibility (CSR) transforms it into a mechanism of ethical accountability, bridging the gap between profit maximization and equitable access to medicines.

Finally, digital transformation amplifies the potential of cost accounting systems. The integration of ERP and AI-driven analytics enables real-time monitoring, predictive modeling, and the inclusion of environmental and sustainability indicators. These innovations expand cost accounting into a multidimensional governance tool that supports not only economic but also ecological and social performance.

5.2. Managerial implications

From a managerial standpoint, the findings underline the need for pharmaceutical companies to transition toward hybrid costing architectures that combine regulatory compliance with managerial flexibility. Firms are encouraged to:

- Implement activity-based or process-based costing models to capture the real drivers of cost variability;
- Integrate cost data into strategic dashboards for R&D portfolio management and market access planning;
- Use cost transparency as a competitive advantage in negotiations with payers and regulatory agencies;
- Embed ethical performance indicators(affordability and sustainability) within cost accounting reports.

By doing so, companies can achieve a dual outcome: improved internal efficiency and enhanced external credibility. Modern cost systems not only rationalize expenditure but also provide a communication interface between corporate management, regulators, and society.

5.3. Policy recommendations

At the policy level, the research highlights several directions for improving the effectiveness and equity of pharmaceutical cost management across Europe:

1. Standardization of cost accounting practices through EU-level guidance that ensures comparability and transparency across member states.
2. Integration of cost-based data into national health technology assessment (HTA) procedures, ensuring that reimbursement decisions reflect verifiable cost structures.
3. Incentivization of digitalization by supporting the adoption of ERP and AI-based systems in small and medium-sized pharmaceutical enterprises.
4. Promotion of ethical cost reporting through voluntary codes of conduct aligned with EFPIA and IFPMA standards.
5. Public-private partnerships for developing training and benchmarking tools in cost accounting and pharmaceutical economics, strengthening the human capital base in this strategic field.

These recommendations align with the broader European objectives of fostering sustainable healthcare systems, encouraging innovation, and ensuring financial protection for patients (Yerramilli et al., 2018; EFPIA, 2021).

5.4. Limitations and future research

While the present study offers an integrated conceptual and comparative analysis, it is limited by its reliance on secondary data and by the heterogeneity of national accounting standards. Future research should aim to empirically test the proposed framework using firm-level data, possibly integrating econometric models to quantify the relationship between cost accounting sophistication, profitability, and access to medicines. Additionally, the intersection between digitalization, sustainability reporting, and managerial accounting in pharmaceuticals represents an emerging field deserving of further investigation.

5.5. Final remarks

In conclusion, cost accounting methods stand at the core of the pharmaceutical industry's capacity to combine efficiency, innovation, and social responsibility. As health systems face increasing financial and ethical pressures, the modernization of cost accounting emerges as both a managerial necessity and a moral imperative. Transparent, data-driven, and ethically oriented cost management is no longer an optional feature—it is the foundation for sustainable value creation and the key to reconciling economic performance with the public good.

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