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REVIEW ARTICLE

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Scoping review of methods used to calculate the costs of an undergraduate medical course.

Metodologias para calcular os custos de um curso de graduação em Medicina: uma revisão de escopo

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ABSTRACT

Introduction: Brazil had 373 medical courses authorized by the Ministry of Education in July 2021, with 229 being in private institutions and an average monthly tuition rate of R$8,242.70. The vast number of resources involved in tuition, scholarships, and grants (PROUNI, FIES, and so forth) justifies the effort required for this activity.

Objective: The review sought to find approaches for analyzing the cost of training doctors, categorizing them according to the level of education and cost scope.

Method: Given the irregularity and methodological inadequacies around interest, the chosen methodology was a scoping review.

Result: The literature search in Portuguese and English yielded 24 articles, which were divided into nine categories depending on their content focus and the study interests.

Conclusion: The lack of methodological agreement, as well as the pressure to optimize resources and evaluate educational efficacy, highlight the need for the development of methods to determine the costs of undergraduate medical education.

Keywords: Costs and Cost Analysis; Medical, Education; Health Workforce; Medical Education; Education, Medical, Undergraduate.

RESUMO

Introdução: *Em julho de 2021, o Brasil tinha 373 cursos de Medicina autorizados pelo MEC, dos quais 229 de instituições privadas, com um valor médio de mensalidade de R$ 8.242,70. O grande volume de recursos envolvidos em mensalidades, bolsas e fomentos (Prouni, Fies etc.) justifica o esforço envolvido neste trabalho.*

Objetivo: *A revisão visou identificar as metodologias de análise de custo de formação de médicos, classificando-as segundo categorias de nível de ensino e abrangência do custo.*

Método: *A metodologia escolhida foi a revisão de escopo, dado que a produção na área de foco é irregular e com lacunas metodológicas.*

Resultado: *As buscas em português e inglês resultaram na seleção de 24 textos, que foram agrupados em nove grupos, elaboradas a partir do foco de seus conteúdos combinados com os interesses da pesquisa.*

Conclusão: *A inexistência de consenso metodológico e a busca por otimizar recursos e avaliar a eficácia do ensino reforçam a necessidade do desenvolvimento de metodologias de apuração de custos da graduação em Medicina.*

Palavras-chave: *Custos e Análise de Custo; Educação Médica; Recursos Humanos para a Saúde; Educação de Graduação em Medicina.*

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INTRODUCTION

The expansion of private higher education has been considered one of the most dynamic and accelerated characteristics of the education sector in the 21st century[1]. In Brazil, mainly in the last two decades, higher education configuration has followed this profile with a significant increase in the number of courses, vacancies, and enrollments, in addition to transformations in the administrative-legal format of institutions and teaching modalities and courses. In the period from 1995 to 2015, the number of private higher education institutions in the country increased from 684 to 2,069, corresponding to an increase of 202%[2]. This market was boosted by the establishment of government programs to expand access such as: the Student Financing Fund (FIES, *Fundo de Financiamento Estudantil*) and the University for All Program (PROUNI, *Programa Universidade para Todos*), established respectively by Laws number 10,260 of July 2001 and 11,096 of January 2005[3,4].

Regarding health degrees, despite the specificities of each profession, their dynamics, regulatory mechanisms and respective job markets, the expansion of private courses is also a reality. Between 1991 and 2014, the proportion of private courses in the area increased from 51% to 72% and the number of vacancies from 61% to 91%.

In the case of medical courses, from 2004 onwards, the participation of private institutions started to show higher rates than those related to the public sector. In 2013, a new cycle of expansion regarding the number of courses and vacancies started, mainly in the private sector, driven by the promulgation of Law Number 12,871, which established the More Doctors Program (PMM, *Programa Mais Médicos*). In addition to the emergency recruitment of doctors to provide care in priority regions through the Brazilian Unified Health System (SUS, *Sistema Único de Saúde*), the PMM authorized the expansion of the offer of medical courses and vacancies in public and private institutions.

In 2014, the country had 248 medical courses with an annual offer of 20,340 vacancies, of which around 54% were in the private sector[5]. In July 2021, the number of courses increased to 373 and the percentage of private vacancies reached 70% with a mean monthly tuition fee of R$8,242.70.

The complex nature of the course requires, in addition to classrooms, other physical infrastructures such as libraries, clinical and IT laboratories, outpatient clinic and hospital structures for clinical practice and diverse human resources, factors that combined guarantee the possibility of including projects of extension and research during the six years of the medical course and make the educational proposal expensive in any economy[6-9].

This complexity requires regulation by the government and civil society, which in Brazil is carried out by the Ministry of Education and Ministry of Health, with the participation of the National Health Council and the Federal and Regional Councils of Medicine, in addition to the Brazilian Association of Medical Education and the Brazilian Medical Association. These institutions generally focus on ensuring the quality of the courses, with costs being relegated to a secondary level.

It is worth remembering that the Federal Constitution of 1988 (Art. 200) defines that the organization of the training of human resources in health is the responsibility of the SUS. Thus, the need to serve the population puts pressure not only on the availability of doctors, but also on the quality of their professional training.

Therefore, given the continuous and accelerated process of expansion of private medical courses in the country, it is important to analyze the costs of this training, considering not only factors such as the duration of the course, the need for students' full dedication and the high costs of monthly tuition fees that affect the family budgets, but also public investments in relation to government action that provides fiscal support to access and funding programs aimed at training such as PROUNI and FIES. Moreover, it is worth highlighting that the structural component for practical medical training for many private institutions is currently facilitated by partnerships with the public sector, a requirement of the PMM public notices.

Considering that all courses follow the National Curricular Guidelines (DCN, *Diretrizes Curriculares Nacionais*), the extreme differences in monthly tuition fees are difficult to explain. The idea that quality gains correspond to a marginal increase in costs can subsidize political decisions in relation to the training process, not only in relation to public resources allocated for this purpose, but in guaranteeing the quality of training and consequently the quality of care that these professionals will provide to society[10].

To minimize the subjectivity involved in these decisions, it is necessary to seek methodologies capable of being used as a reference measure to evaluate both the quality of the result (effectiveness) and the costs of the process (investment efficiency).

Based on this perspective, the aim of the present study was to identify methodologies to analyze the cost of medical training in the scientific literature, classifying them according to cost-determining factors and their scope.

METHOD

A scoping literature review[11] was carried out considering different methodological steps, such as identification of the research question; planning and creation of a protocol for

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selecting search terms and databases; performing of the research based on this protocol; mapping of data according to the research question and synthesis of results.

The guiding question was aimed at knowing the cost calculation methodologies existing in academic literature related to medical graduation. However, in the search protocol, in addition to "medicine", we chose to include the keywords "nursing" and "health" aiming to obtain a greater volume of information.

The search terms were defined considering the union of three areas: Health (medical, Nursing, health), Education (education, school, graduation, undergraduate course) and Economics (cost efficiency, cost analysis, cost methods, standard cost, direct service cost, cost measurement, pricing).

The choice of databases considered digital bibliographic references specialized in health (Virtual Health Library - VHL; PubMed and EMBASE) and education (Academic Search Premier (ASP) – EBSCO) and multidisciplinary databases (Web of Science; Applied Social Sciences Index and Abstracts (ASSIA) – PROQUEST, and Scopus).

To combine search terms, the Boolean operators "OR", "AND" and "NOT" were used, the latter with the purpose of excluding results related to the words "veterinary" and/or "care", whose approaches are not part of the scope of the research. This option arose from the fact that the veterinary course in many countries is called "veterinary medicine", and the word "care" is related to care services. There were no restrictions related to the year of publication or language.

The search resulted in a total of 663 publications distributed across the seven assessed databases: Web of Science (70); Medline/PubMed (289); Scopus/Elsevier (124); VHL/Bireme (12); Embase/Elsevier (44); CINAHL /EBSCO Host (117) and ASSIA /ProQuest (7).

This result was sent to the Rayyan platform (https://www.rayyan.ai/) with the aim of facilitating and speeding up the selection of publications of interest for the research.

Of this total number of articles, Rayyan identified 205 duplicate publications, leaving a total of 458 studies that were evaluated by two researchers by reading the titles and abstracts, excluding those not related to the construction of a methodology for calculating medical training costs. In cases of disagreement, a third reviewer was consulted.

Thirty-nine (39) articles were chosen for full-text reading and arranged in an Excel spreadsheet containing, in addition to identification information imported via Rayyan, (title, authorship, year, journal and publication language), the Digital Object Identifier (DOI), the type of study, the assessed course (medicine or other), the assessed level of education (undergraduate; postgraduate course or professional training), the types of costs evaluated (direct, indirect, fixed, variable, recurring, capital and/ or opportunity); the scope of the calculated cost (per student, per program, cost per student and program or cost per professional), the use or not of curricula as a methodological basis; the number and type of involved institutions (institution, programs; departments, or services) and a list of references used in articles related to the research subject. All information conforms to the analysis variables used in this research.

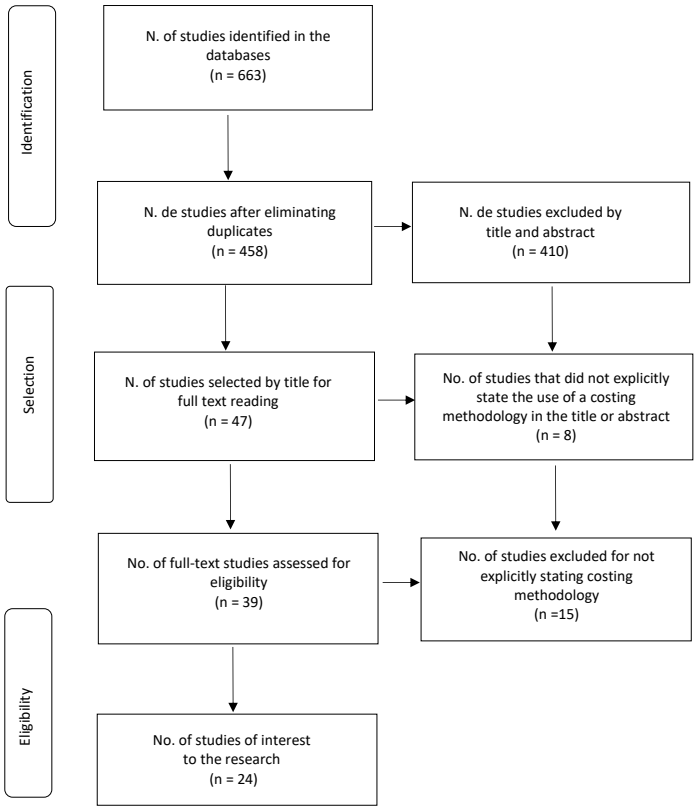
The explanation of the use of the cost calculation methodology was applied as an eligibility criterion to the 39 articles, and at the end of this process, 24 articles were identified, whose methodological steps that guided this bibliographic review are shown in Figure 1

PRESENTATION AND ANALYSIS OF RESULTS

As a result of implementing the described methodology, Table 1 depicts the 24 articles included in the research listed by year of publication.

Aiming at providing greater clarity of the results, we chose to present them considering two perspectives of analysis. In the first, attention will be paid to the bibliometric analysis of production, its origin and distribution. In the second, we

Figure 1. Information flow with the different phases of the literature review.



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present the data according to the categories and subcategories of research interest, having as primary units of analysis the types and scope, and of the cost, the methodological basis and the types and levels of courses.

Quantitative bibliometric analysis

The 24 selected articles were published by 21 journals, originating from six countries and from five regions: Africa, North America, South America, Europe, and Oceania. Together, the American countries hold 79% of production in the field [United States (14- 75%), Brazil (4 - 20% and Canada (1- 5%)]. Of the total publications, 21 (87%) were written in English and three in Portuguese (13%).

The distribution by dates revealed the availability of publications from the end of the 1950s to 2015, as shown in Figure 2.

Table 1. Selected articles.

YEAR	AUTHOR	TITLE	JOURNAL	LANGUAGE	COUNTRY OF ORIGIN
1958	Knott LW; Gooch M and Hillard HE	The cost of medical education: a pilot study.	Journal of Medical Education	English	USA
1964	Hill KR	Cost of Undergraduate Medical Education in Britain.	British Medical Journal	English	England
1973	MacBride O	How much does medical education cost? A review	Health Manpower Policy. Discussion Papers Series	English	USA
1987	Kummer K; Bednash G and Redman B	Cost model for baccalaureate nursing education.	Journal of Professional Nursing	English	USA
1990	Roberts PM	Financial arguments and university education for nurses: a Canadian perspective.	Nurse Education Today	English	Canada
1994	Smith WL; Erkonen W.E. and Hough D.E.	Calculating the costs of undergraduate medical education in radiology.	Investigative Radiology	English	USA
1994	Namate DE	The cost of registered nurse-midwifery education and enrolled nurse-midwifery education in Malawi, Central Africa.	Journal of Advanced Nursing	English	Malawi
1997	Goodwin MC; Gleason, WM and Kontos, HA	A pilot study of the cost of educating undergraduate medical students at Virginia Commonwealth University.	Academic medicine: Journal of the Association of American Medical Colleges	English	USA
1997	Franzini L; Low MD and Proll MA	Using a cost-construction model to assess the cost of educating undergraduate medical students at the University of Texas--Houston Medical School.	Academic medicine: Journal of the Association of American Medical Colleges	English	USA
1997	Rein MF; Randolph WJ; Short JG; Coolidge KG; Coates ML and Carey RM	Defining the cost of educating undergraduate medical students at the University of Virginia.	Academic medicine: Journal of the Association of American Medical Colleges	English	USA
2001	Bicknell WJ, Beggs AC and Tham PV.	Determining the full costs of medical education in Thai Binh, Vietnam: a generalizable model	Health Policy and Planning	English	USA
2004	Jerico MC and Castilho V.	Training and development of the nursing staff: a model of spread sheet cost.	Revista da Escola de Enfermagem da USP	Portuguese	Brazil
2005	Starck PL	The cost of doing business in nursing education.	Journal of Professional Nursing	English	USA
2009	Bobroff MCC; Gordan PA and Garanhani ML	Total educational costs of an integrated nursing curriculum.	Revista Latino-Americana de Enfermagem	English	Brazil

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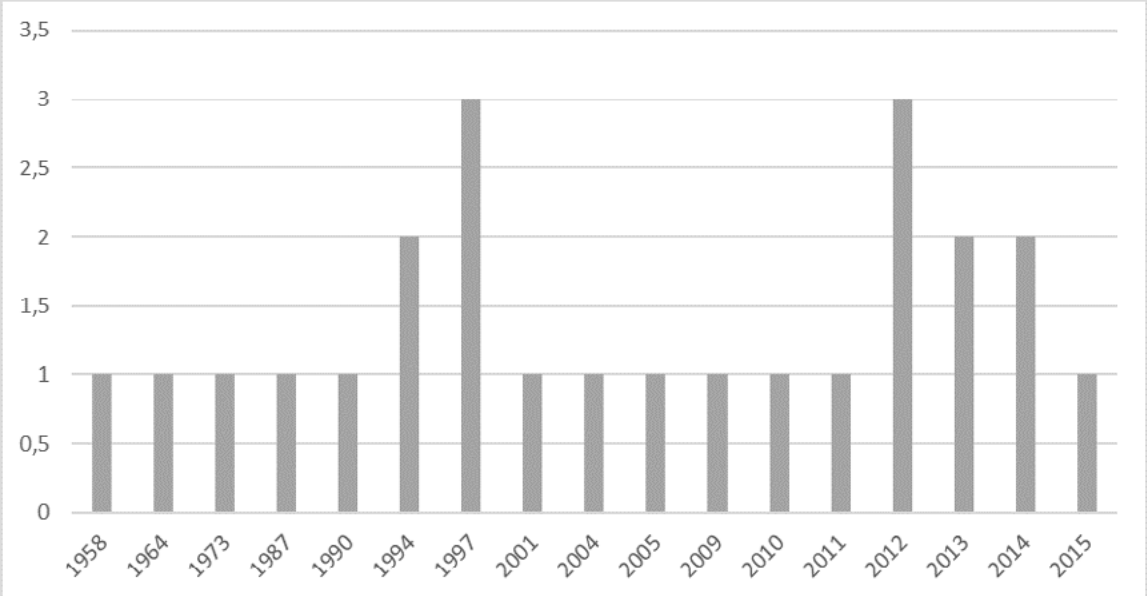
Quadro 1. Continuation.

YEAR	AUTHOR	TITLE	JOURNAL	LANGUAGE	COUNTRY OF ORIGIN
2010	Bobroff MCC; Garanhani, ML; Gordan, PA and Martins, JT	Costs on nursing education: a review.	Ciência, Cuidado e Saúde	Portuguese	Brazil
2011	Gammon E and Franzini L	Revisiting the Cost of Medical Student Education: A Measure of the Experience of UT Medical School-Houston.	Journal of Health Care Finance	English	USA
2012	Bobroff MCC; Gordan, PA and Garanhani, ML	Actual and required faculty work: education cost in nursing.	Ciência, Cuidado e Saúde	Portuguese	Brazil
2012	Goulston K; Oates K; Shinfield S. and Robinson B.	Medical student education: what it costs and how it is funded.	Internal Medicine Journal	English	Australia
2012	Schieffler Jr DA; Azevedo BM; Culbertson RA and Kahn MJ	Financial implications of increasing medical school class size: does tuition cover cost?	The Permanente Journal	English	USA
2013	Oates RK and Goulston KJ	The hidden cost of medical student education: an exploratory study.	Australian Health Review	English	Australia
2013	Zendejas B; Wang AT; Brydges R; Hamstra SJ and Cook DA	Cost: the missing outcome in simulation-based medical education research: a systematic review.	Surgery: Journal of the Society of University Surgeons	English	USA
2014	Walsh K	Research into cost and value in medical education: can we make findings more generalisable? Commentary.	Annali dell'Istituto Superiore di Sanità	English	USA
2014	Ben-Ari R; Robbins RJ; Pindiprolu S; Goldman A and Parsons PE	The costs of training internal medicine residents in the United States.	The American Journal of Medicine	English	USA
2015	Walsh K.	Cost in medical education: one hundred and twenty years ago	Adv Health Sci Educ Theory Pract	English	England

Source: Created by the authors.

Figure 2. Number of texts per year of publication.



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Over these 57 years (1958-2015), the journals with the highest volume of publications were the Journal of the Association of American College, the Journal of Professional Nursing and *Revista Ciência, Cuidado e Saúde*, responsible for two titles each. Together these three journals were responsible for 25% of the total production. The other journals, responsible for the remaining 75% of production, contributed one article each.

Most studies (83%) were categorized as qualitative and quantitative, while literature review studies accounted for 17%.

Analysis of categories and subcategories of interest

The articles were grouped according to categories and subcategories of research interest, having as the focus the cost-determining factors.

In the "scope of the calculated cost" category, 50% of the articles refer to "cost per student". The subcategories "cost per program" and "cost per student and program" corresponded to 12% and 2% respectively. The analysis of the "types of evaluated costs" revealed that 68% of the articles reported the calculation of "direct and indirect costs".

In the "level of education" category, articles on undergraduate courses accounted for 62% of the total production, while articles on postgraduate courses corresponded to 25%. Articles related to to undergraduate and postgraduate studies corresponded to 8% and training for service to around 4%.

Of the total articles analyzed, 13 (54%) used the course curriculum as the methodological basis for calculating costs. Another seven (29%) did not use this methodological resource, with the remaining four articles not falling into this category.

Taking the "type of course" as the basis of analysis, the "Medicine" subcategory was responsible for 63% of the analyzed production, while "Nursing" and "Other health professions" accounted for 33% and 4% of the total articles, respectively.

Subsequently, the categories and subcategories of interest shown in Table 2 were correlated from the outside to allow the organization of the articles into nine axes of analysis as discussed below.

Undergraduate or postgraduate medical courses that used the curriculum as the methodological basis for calculating costs per student.

Bicknell *et al*.[8] developed a model to calculate costs incurred during the six-year medical course duration at Thai Binh Medical School – Vietnam, based on four components: Preparatory work, medical science, clinical theory (classroom) and clinical practice (hospitals, clinics, and health centers). Actual annual expenditures by curriculum component and academic year were determined by combining the curriculum analysis with the institution and hospital clinical center budget data. The curriculum analysis was determined based on the percentage allocation of hours per component/year considered, in addition to staff spreadsheets (teaching and non-teaching staff), the time spent on short-term and postgraduate courses.

Goodwin et al.[12] developed a model to isolate the cost and sources of annual funds per student for the Virginia Commonwealth University Medical College undergraduate course program. Indirect and direct cost factors such as faculty and support staff salaries, fringe benefits, maintenance costs, and support services were identified. Student/faculty and resident contact hours were determined through the curriculum schedule, internship rotations, and enrollment in elective courses.

Oates et al.[13] estimated, based on detailed course timetables, teaching time at Sydney Medical School for a convenience sample of third- and fourth-year postgraduate students in 2010. They considered, in addition to clinical supervision and research hours, the extra time spent by faculty on hospital tasks with the students, preparing lectures, travel, assessments (including from other healthcare providers not paid by the university) and added infrastructure costs to estimate the annual cost per student.

Rein et al.[14] calculated the cost of the undergraduate course at the University of Virginia based on curricular hours of faculty/student contact inside and outside the classroom, considering the ratio of one faculty member to two students

Table 2. Categories and subcategories of interest.

Categories	Subcategories
Scope of the calculated cost	Cost per student
	Cost per program
	Cost per student and program
Types of evaluated costs	Direct costs
	Indirect costs
	Direct and indirect costs
Level of education	Undergraduate course
	Postgraduate course
	Training for the service
Methodological Basis	Considers the curriculum
	Does not consider the curriculum
Types of course	Medicine
	Nursing
	Other health areas

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in the first two years. For the third and fourth years, due to the clinical internships, an additional 67% of time was assumed for outpatient clinical care and 25% for surgical practice. A full-time administrative staff member was assigned to support four teachers and eight and ten hours per week of direct contact for teaching respectively basic and clinical sciences. They conclude that the cost of medical education is largely based on assumptions about faculty teaching time.

Smith et al.[15] analyzed the costs of the radiology department participation in the curricular offering of an introductory course in clinical medicine for the second year of undergraduate studies at the University of Iowa. They considered opportunity costs (alternative use of instructional resources) and marginal costs (real additional cost involved in creating/delivering the course) including faculty time, test preparation and monitoring functions, in addition to the use of facilities based on their square footage without, however, considering its maintenance.

Undergraduate or postgraduate medical courses that used the curriculum as a methodological basis for calculating costs per program and per student.

Franzini *et al*.[16] used a model to determine the economic costs of 200 undergraduate students from the University of Texas-Houston Medical School by calculating the demand for educator contact hours (ECHs) according to curriculum requirements. They calculated the number of required teachers and added the ECHs to the time spent on research and meetings, costs incurred with salaries and benefits and with equipment and maintenance to determine the costs of the program and per students without, however, considering clinical practice. The model also included indirect costs such as support and administration, equipment, maintenance, and operation of the institutional environmental plant.

Gammon et al. [17] used a model to estimate the individual and four-year costs of the program at the University of Texas-Houston Medical School in 2006 and 2007 and compared them with data from a curriculum-based survey carried out in 1997. The model calculated three types of costs: instructional costs (direct contact teaching), educational costs (instructional costs and general supervision), and environmental costs (educational and research costs). The variables included the number of enrollments, student/faculty and resident contact hours, activity profile by type of educator, salary costs, and support resources. A sensitivity analysis was performed to estimate costs in different scenarios and the results were analyzed from a comparative perspective.

Undergraduate or postgraduate medical courses that did not use the curriculum as a methodological basis for calculating costs per student.

Goulston *et al*.[18] determined the annual costs per student incurred in undergraduate studies at the University of Sydney by summing the salaries of the teaching staff and support staff and dividing it by the number of students. Costs such as security, administrative and library services were excluded, as they were considered costs for the entire university as well as the cost of all institutional centers without teaching activities.

Schieffler Jr. et al.[19] used linear regression and information from income reports from the Association of American Medical Colleges (AAMC) database to estimate undergraduate course costs. They considered the number of registrations, monthly fees, total fees and government and family support. They included total revenue from donations and endowments in the calculation, stating that many institutions pay scholarships to students or professorships, both of which incur costs. However, research grants supported by federal contracts, other income from donations and contracts, total expenses and transfers of hospital funds were not included in the calculation because they are not clearly identified in medical training. They conclude that increasing class sizes, as recommended by the AAMC in 2016, will not lead to greater revenue for schools, as the cost of teaching exceeds the registration and monthly fees.

Walsh[20] followed the Family Medicine Network Evaluation Project of the University of Washington for three years to estimate its cost per student, comparing it to the costs of the Family Medicine Residency Program. Using research data from 2000, it analyzed, from a comparative perspective, the current direct and indirect revenues, and expenses of the program: human resources, information services, billing and collections, administrative support, physical plant (rent or mortgage) and associated expenses (telephone, maintenance, etc.), capital revenues (equipment purchases) and benefit and/or retirement packages for family medicine service employees. The author concluded that although revenues increased during the research period, the expenses increased relatively more, increasing the cost per resident.

Hill[21] sought to justify the cost per student as determined in a 1963 study. All calculations were compared to pre-existing studies and reports based on the sum of the total expenses of all schools and non-university hospitals included in the study. However, the author does not explain which cost items were considered. Starting from the premise that the cost of medical training can be divided between the cost of medical school and the cost of the health system, the author declares

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that calculating medical training is a complex task and full of debatable assumptions, making it difficult to separate the training costs incurred in college from those incurred under the healthcare system.

Undergraduate or postgraduate medical courses that did not use the curriculum as a methodological basis for calculating costs and programs per student.

Knott *et al*. [22] carried out a pilot study through a partnership between Emory University and the Atlanta/Georgia Public Health Service with the objective of developing a method for analyzing the average cost of education considering direct and indirect costs based on general institutional expenses. To determine the cost of the medical program and the cost per student, institutional expenditures were analyzed according to functional activities, with expenditures on research grants, clinical patient care and other community services not being considered as part of the cost of professional training.

Undergraduate nursing courses that used the curriculum as a methodological basis for calculating costs per student.

Bobroff *et al*.[23] constructed a model for estimating costs of the integrated nursing curriculum at a public university in the state of Paraná based on the institutional Cost Analysis and Construction Program. Instructional costs, shared costs and total educational costs were calculated, including the number of "Teacher Contact Hours" (TCH), teacher remuneration and the base-activity costs (direct costs allocated to preparation, control of activities and interviews). To estimate the costs per student, the costs incurred with supporters (managers, committees, and module coordination), the shared costs of the university hospital and the number of students per month/grade were also considered.

Bobroff et al.[24] tested a Model for Estimating Total Educational Costs of the Nursing Course (MECCC) at *Universidade Estadual de Londrina* (UEL) to estimate educational costs based on TCH spent on theoretical and practical teaching per student. Following institutional analysis parameters, documents from the higher education institution documents were analyzed and interviews were carried out using a convenience sample with 52 teachers using a pre-structured script aiming at comparing the results.

Roberts[25] estimated the costs of the various disciplines at the University Schools of Nursing in North America for the years 1981/1982 and 1984/1985. To calculate the cost per undergraduate and/or postgraduate student, they considered the institutional costs related to teaching on the main campus for each teaching unit, including all salaries (faculty, staff, research assistants, and others), operating costs (supplies, telephone bills, photocopying, etc.), and capital costs (computers, teaching material, etc.). To estimate the average unit cost of a course section, regardless of its level, the total expenditure of the teaching unit for each fiscal year was divided by the total number of sections taught by the unit in the year/student. The regression equation for the relationship between the length of sections taught was calculated according to the course level.

Undergraduate Nursing courses that used the curriculum as a methodological basis for calculating costs per program.

Kummer *et al*.[26] started from the review of the curricula of the bachelor's degree courses in Nursing and the requirements of the Class Council in the United States to develop a cost model. Direct and indirect costs collected by nationwide research were incorporated to estimate the total institutional costs of undergraduate programs in the area. The developed model defines the cost components based on the number of students enrolled in existing bachelor's degree programs nationally, considering the different curricular models with the aim of being representative of all programs. Although the cost estimates produced by the model are derived from initiatives constructed nationally, differences in values were identified when applying the model in different regions of the country. According to the authors, the differences occurred due to the influence of both the number of teachers and students of the different existing courses and the size of their teaching and clinical schedules.

Undergraduate Nursing courses that did not use the curriculum as a methodological basis for calculating costs per program.

Jerico et al.[10] disclosed the creation of a spreadsheet to calculate the cost of a nurse training program carried out in a Continuing Education Center of a hospital institution in the interior of the state of São Paulo, Brazil. Direct costs with instructors, materials, audiovisual resources, and general training expenses were considered, in addition to indirect costs related to the local structure, regardless of the training process, such as electricity, administrative costs and depreciation.

Namate[27] analyzed the factors that influence the total cost of training in obstetric nursing at a university in Malawi, Africa. The data were collected in a standard form developed based on costs: direct and indirect. Direct cost included salaries and fringe benefits for full-time faculty, administrators, and support staff, as well as consumable supplies and materials, student travel and seminars, external examiner attendance expenses and workshops. Indirect cost included all costs of

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functional areas that supported instructional activities, such as the library, student services, facilities maintenance, capital costs, and off-campus administrative activities such as advertising and graduation ceremonies.

Undergraduate and postgraduate nursing courses with cost calculation per programs and students.

Starck[28] presents an overview of the cost of undergraduate nursing based on studies such as that of the National League of Nursing, which produced a Manual to analyze expenses and costs per student/year in 1980; from the United States Department of Health and Human Services, which produced and published the Cost Estimation Model for Basic Nursing Education to calculate direct, indirect and capital costs and from the American Association of Colleges of Nursing based on the database data used to compare state school allocations per programs, tuition and fees divided by the number of students. It emphasizes that systems operate both based on costs (include the calculation of all components necessary for production) and on revenues, which are generally simpler to calculate (allocated funds divided by the number of students enrolled plus monthly fees, charges, and other funds).

Literature review studies

Bobroff *et al*.[29] carried out a literature review study to identify, describe and analyze scientific articles on costs in undergraduate nursing as part of the construction stages of the Educational Cost Estimation Model for this area of knowledge at UEL. They emphasize that different denominations were used by the authors to express direct, indirect, and institutional costs, with no consensus in determining costs as well as in the different estimation models used.

Ben-Ari et al.[30] sought to estimate the real costs of training an internal medicine resident in the United States according to the requirements of the Accreditation Council for Graduate Medical Education (ACGME) based on reviews of studies on training costs in internal medicine and other disciplines. They included fixed administrative costs of residency programs as well as variable training costs depending on their size. To define costs per resident, an update was made incorporating the ACGME requirements into the minimum standard cost model as stipulated by the Health Care Financing Administration for reimbursement of educational costs by Medicare and published in 2001 by Nasca et al [31].

MacBride[32] carried out a review of the literature on medical school costs with the aim of evaluating and comparing methodologies and results. The research covered studies from one or more schools that produced figures for the average annual cost per student and/or discussed the methodologies and issues involved in producing these figures such as "net contributed value", "cost" and "supply-product analysis". The empirical results of these studies did not demonstrate a consistent pattern of costs over time when adjusted for inflation, which may be related to an increase in the quality of the education process.

Zendejas et al.[33] undertook efforts in a conducted systematic review, seeking to answer which components affect the cost of simulation-based medical training. A pretext framework relating educational cost-effectiveness was used to identify categories of resources such as personnel, facility, and equipment and materials costs. They emphasize that estimating the opportunity cost of staff time, training benefits and clinical expenses requires approximations and assumptions that vary from institution to institution.

FINAL CONSIDERATIONS

The research disclosed a lack of studies in the literature focused on the development of cost calculation methodology related to medical teaching. Furthermore, the analysis of academic production allowed us to perceive that there is no consensus among authors, either in the allocation or in the use of cost estimation methodologies. The diversity of the use of factors determining cost, duration and ambience required for courses makes it impossible to structure a benchmark of comparable efficiency between different institutions.

Most of the studies focused on determining the cost per student or per program, considering mainly the direct costs related to personnel expenses, which brings them closer to spending issues than to the operational cost of training.

In general, the authors do not describe the methodologies used in the pedagogical design of the course curricula, instead focusing on disciplines, departments, basic sciences and/or clinical practice of specialties. Similarly, they did not show any concerns about detailing the methodology used to calculate investment costs. This was also observed in relation to the calculation of training costs in hospital and outpatient clinic environments. Some authors highlight the importance of surveying educational costs incurred in these environments without, however, describing a methodology for doing so.

Given the sociopolitical importance of medicine and the magnitude of the financial amounts spent by the government in providing scholarships and grants, as well as those incurred by the families, it becomes essential to measure the cost of training these professionals.

Therefore, we consider research efforts aimed at developing cost calculation methodologies capable of not only optimizing the public resources employed in this area

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of knowledge to be opportune and necessary, but above all evaluating the effectiveness of teaching and justifying the efficiency of the investment.

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AUTHORS' CONTRIBUTION

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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