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MAPPING THE GLOBAL DRG-BASED CLINICAL KNOWLEDGE LANDSCAPE: IMPLICATIONS FOR CLAIMS MANAGEMENT AND THE EVOLVING ROLE OF CLINICAL CODERS

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Abstract

This bibliometric research aims to map the most researched disease trends globally and their implications for preventing or reducing the risk of hospitals experiencing financial losses by strengthening the role of coders in DRG-based financing systems. The study applied a bibliometric analysis to literature collected from the PubMed database using structured keywords related to clinical coders, DRG/case-mix, and reimbursement, with inclusion criteria limiting article types to only English-language articles. The data reduction yielded 4,280 final articles, which were exported to .txt format and analyzed using VOSviewer and Microsoft Excel. Network map analysis reveals that treatment outcomes keywords dominate the network's central metrics. The knowledge structure is divided into four main clusters: (1) chronic multimorbidity profile and economic impact evaluation; (2) complex oncology target therapy and prognosis; (3) treatment of genetically mutation-based non-small cell lung cancer; and (4) mitigation of the global pandemic of health insurance. The analysis of time trends shows a clear evolution in research, from the adaptation phase of the pandemic crisis to the precise management of modern diseases and the use of internal hospital governance instruments, such as severity-of-illness indices and risk assessment. Implications: The accuracy of the clinical coder's codification of clinical variables (cancer stage, comorbidities, and complications) affects the appropriate severity level, helping prevent financial losses for the hospital due to under-coding and underpayment. The novelty of this research lies in providing a transparent, systematic, and replicable scientific mapping of the direction of research on the relationship between clinical coding and the DRG financing system.

Keywords: Chronic Multimorbidity, Claims Management, Clinical Coder, Diagnosis Related Groups, Health Insurance

INTRODUCTION

Controlling health insurance cost inflation is now the focus of global health financing reform in achieving Universal Health Coverage. This is realized through the transition to a prospective payment system that refers to Diagnosis-Related Groups (DRG) (Saizan et al., 2021; Mehmood et al., 2023). However, the adoption of new medical technologies and the shifting burden of chronic diseases pose a severe challenge to hospitals' financial resilience (Du, Fang and Zhang, 2025; Reka et al., 2025). The adoption of new high-cost medical technologies widens the gap between hospitals' actual operating expenses and the claimed standard package rates (Kaskirbayeva et al., 2025; Reka et al., 2025). On the other hand, errors or omissions in the process of codifying primary diagnoses, procedures, and secondary diagnoses by coders result in a shift in the Major Diagnostic Category (MDC) group and a decrease in severity level, resulting in hospitals suffering massive financial losses due to under-coding that triggers underpayment of claims (Saizan et al., 2021; Asadi et al., 2022).

Although the implementation of a DRG-based financing system has been extensively researched, the previous literature remains generally limited to the analysis of cost efficiency and macro policies of payment systems, without considering the dynamics of its technical implementers (Ni et al., 2024; Chang et al., 2025). As a result, there is a significant knowledge gap regarding how the strategic role and competence of clinical coders in supporting hospital financial resilience are developed. (Yu et al., 2024; Fu et al., 2025). This bibliometric research is important for filling this gap by mapping the global knowledge structure to better understand the vital role of clinical/medical coders in the DRG financing system, thereby promoting professionalism and rigor in their work. This study presents the following research question: RQ1: What are the main themes and knowledge clusters in the global literature

regarding the role of clinical coders in DRG-based financing systems? RQ2: How have the chronological trends of the research themes evolved? RQ3: What are the current research gaps, and where are the prospective future research areas in this field?

LITERATURE REVIEW

The Case-Mix and DRG systems classify hospital patient types based on clinical similarities and resource utilization patterns (Gao et al., 2026). The magnitude of the DRG rate and the case group are based on four main variables, namely primary diagnosis, secondary diagnosis, medical procedure, and patient discharge status (Islam et al., 2021) Secondary diagnosis variables, such as comorbidities and complications, can increase case severity from level 1 (mild) to level 3 (severe). The accuracy of the coding to the severity level affects the amount of reimbursement package rates that hospitals will receive from third-party payers (Albagmi, 2024; Zhang, Tang, et al., 2024). Failure to record these secondary clinical variables increases the risk of loss, threatening a decrease in hospital operational profitability (Islam et al., 2021; Saizan et al., 2021). Management of chronic diseases with complex multimorbidity is the main burden of increasing hospital service costs (Nicolet et al., 2022). The interplay of metabolic disorders—including obesity, hypertension, and type 2 diabetes—not only elevates the likelihood of catastrophic medical events but also drives up the consumption of healthcare resources (Xiang et al., 2025a). Patients with multimorbidity complexity also have a very high probability of readmission and post-operative complications, adding to the burden on healthcare workers and threatening the hospital's financial profitability (Cao et al., 2024). Cost efficiency analysis is carried out through standardization of clinical guidelines or clinical pathways and the use of rational drug formularies aimed at minimizing the waste of health service resources (Wu et al., 2025a). However, clinical pathways often struggle to accommodate unpredictable variation in multimorbidity patients with high complexity, which is a challenge for hospital management to balance the clinical standardization of patients with complex care with hospital cost efficiency (Du, Fang and Zhang, 2025; Luo et al., 2026).

The financial stability of hospitals operating within insurance systems is progressively linked to the proficiency and pivotal role of clinical coders. The role of the coder evolved from an administrative function to a strategic part of the hospital's financial risk management (Saizan et al., 2021). A competent coder must have in-depth clinical analysis skills to accurately translate the patient's medical condition into ICD-10 and ICD-9 codes that determine the appropriate grouping for the disease/procedure group (Asadi et al., 2022). Coding accuracy is effective in securing hospital revenue from pending, denied, or disputed claims through insurance verifiers (Islam et al., 2021). Despite the importance of coding accuracy and claims management, previous literature has often analyzed these components separately, either focusing on clinical pathway optimization or on individual coder competencies alone (Saizan et al., 2021; Yu et al., 2024; Chang et al., 2025). There is still a real gap in tracking how the global knowledge structure between claims management, casemix adaptation, and the expansion of the strategic role of clinical coders has evolved collectively, especially in the post-pandemic era. Therefore, a comprehensive bibliometric analysis covering the period 2021–2025 is essential to map the shifting trends of this research, uncover structural gaps, and provide a basic framework for optimizing the role of clinical coders in DRG-based health payment reforms.

METHOD

This study applies a bibliometric analysis to map global trends in the literature on the role of clinical coders in health financing systems using the DRG prospective payment scheme. Literature data were collected from the PubMed database. Data search strategy using structured keyword formulation: ("clinic* coder" OR "medic* coder" OR "medical coder") AND ("diagnosis related groups" OR "case-mix" OR "case based groups" OR "CBG*") AND (reimburse* OR claim* OR payment*).

The search was conducted on May 18, 2026. An initial search without restrictions yielded 329,497 scientific articles in the PubMed database. The application of filters to capture inclusion criteria, including limiting the publication time span of the last 5 years (2021-2025) to capture the latest data trends, regulations, and governance developments. Availability of abstracts and full-texts, as well as specific article types (Books and Documents, Clinical Trial, Meta-Analysis, Randomized Controlled Trial), does not include reviews or systematic reviews. Language restrictions apply only to articles published in English to maintain consistency in interpreting scientific data. The results were reduced to 4,280 final articles. Bibliographic metadata from 4,280 articles were extracted in PubMed format as .txt files, then analyzed using VOSviewer and Microsoft Excel to evaluate relationship strength parameters, clusters, and trends via keyword co-occurrence.

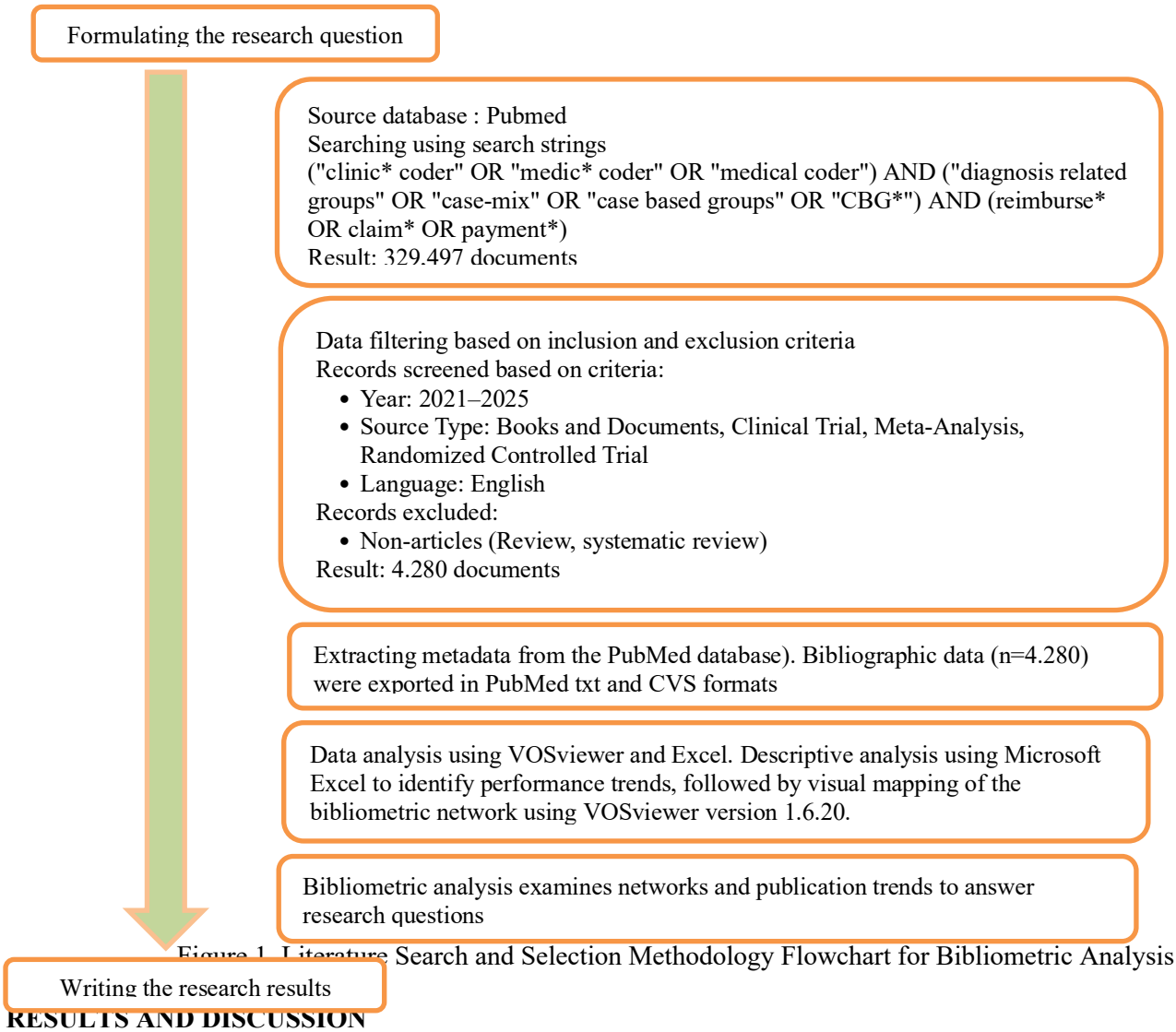

Figure 1. Literature Search and Selection Methodology Flowchart for Bibliometric Analysis

RESULTS AND DISCUSSION

Table 1 summarizes the 10 most influential keywords extracted from metadata that significantly influence cluster formation, as measured by occurrences and total link strength (TLS). The treatment outcome keyword occupies the first ranking position, with a very dominant score, both in terms of frequency of occurrence (1,123 times) and strength of relationship (TLS: 1,891). This proves that the result of patient treatment is the most researched topic and is linked to global health insurance (Wang et al., 2025).

The majority of terms in the top five positions are dominated by vocabulary related to cancer and its therapeutic modalities, such as antineoplastic combined chemotherapy protocols, antibodies, monoclonal antibodies, humanized antibodies, and lung neoplasms. The high value of TLS in these medical terms indicates that cancer management is the most actively debated area of health services within the DRG package fee system. The keywords quality of life and progression-free survival indicate that health administration research also focuses on the long-term impact of medical interventions on patients' quality of life. At the bottom of the top ten list are keywords for systemic chronic diseases, such as heart failure, as well as the terms covid-19 and sars-cov-2. The existence of this keyword indicates that the dynamics of comorbidities and the health system's adaptation during the pandemic remain strong components that affect the governance of hospital claims globally.

Table 1. Top 10 Keywords In The Co-Occurrence Analysis

Rank	Keyword	Total link strength	Occurrences	Avg. pub. year
1	treatment outcome	1891	1123	2024.099

2	antineoplastic combined chemotherapy protocols	1608	548	2023.958
3	antibodies, monoclonal, humanized	1009	379	2023.995
4	lung neoplasms	720	195	2023.985
5	carcinoma, non-small-cell lung	640	151	2024.013
6	quality of life	623	333	2023.814
7	progression-free survival	606	186	2024.382
8	covid-19	538	216	2023.222
9	heart failure	495	168	2023.762
10	sars-cov-2	480	167	2023.317

Source : PubMed Metadata, analyzed with Excel

Table 2 shows that the topics with the most citations in the research world reflect today's trends in high-cost, most complex clinical cases, such as psychiatric genetics and oncology target therapy. The most cited article was the Genome-wide association study (1,294 citations), which involved more than 40,000 cases to discover a new understanding of the biology behind bipolar disorder. Of the ten most cited articles, dominated by the field of oncology/cancer, focusing on clinical trials of cutting-edge drug therapies for cancer, specifically lung cancer (Non-Small-Cell Lung Cancer (NSCLC) and ovarian cancer. Clinical coders are required to accurately detect and input diagnostic codes and comorbidities, including cancer stages, as well as chemotherapy measures. If the coder misses it (under-coding), the hospital will be paid a lower package rate than it should be billed (underpayment), which can aggravate the hospital's losses.

Table 2. Top 10 Articles with the Most Citations

Position	Title	Year	Cited_by	Authors
1	"Genome-wide association study of more than 40,000 bipolar disorder cases provides new insights into the underlying biology."	2021	1294	(Andreassen et al., 2021)
2	"Durvalumab plus tremelimumab alone or in combination with low-dose or hypofractionated radiotherapy in metastatic non-small-cell lung cancer refractory to previous PD(L)-1 therapy: an open-label, multicentre, randomised, phase 2 trial."	2022	201	(Schoenfeld et al., 2022)
3	"Trametinib versus standard of care in patients with recurrent low-grade serous ovarian cancer (GOG 281/LOGS): an international, randomised, open-label, multicentre, phase 2/3 trial."	2022	178	(Gershenson et al., 2022)
4	"First-in-Human, Phase I Dose-Escalation and Dose-Expansion Study of Trophoblast Cell-Surface Antigen 2-Directed Antibody-Drug Conjugate Datopotamab Deruxtecan in Non-Small-Cell Lung Cancer: TROPION-PanTumor01"	2023	129	(Shimizu et al., 2023)
5	"Overall survival in the SIMPLIFY-1 and SIMPLIFY-2 phase 3 trials of momelotinib in patients with myelofibrosis"	2022	48	(Mesa et al., 2022)
6	"COBALT: A Confirmatory Trial of Obeticholic Acid in Primary Biliary Cholangitis With Placebo and External Controls"	2025	36	(Kowdley et al., 2025)

7	"Diagnostic accuracy of ultrasound screening for fetal structural abnormalities during the first and second trimester of pregnancy in low-risk and unselected populations"	2024	29	(Buijtendijk et al., 2024)
8	"Individualized Perioperative Blood Pressure Management in Patients Undergoing Major Abdominal Surgery: The IMPROVE-multi Randomized Clinical Trial"	2025	18	(Saugel et al., 2025)
9	"A Pooled Analysis of Datopotamab Deruxtecan in Patients With EGFR-Mutated NSCLC"	2025	17	(Ahn et al., 2025)
10	"Meta-analysis identifies common gut microbiota associated with multiple sclerosis."	2024	15	(Lin et al., 2024)

Source : PubMed Metadata, analyzed with Excel

Co-word Analysis

Keyword co-occurrence analysis was performed on the metadata of articles obtained from PubMed. Based on the visualization, several important findings emerge regarding the knowledge structure, chronological trends, and the main focus of this literature dataset.

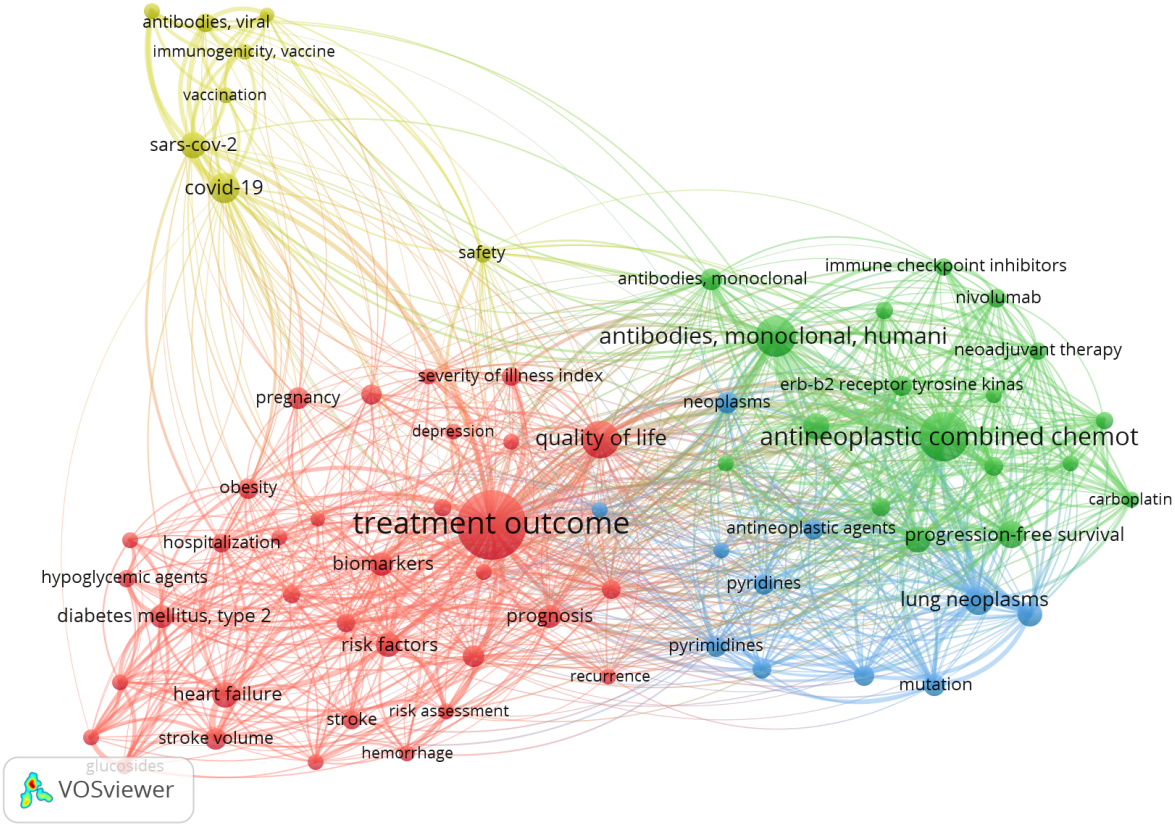

Figure 2. Network Visualization based on Keyword Co-occurrence
Source : Vosviewer Data

Analysis of the VOSviewer network map cluster yields four main knowledge groups that reflect the close relationship between clinical topics and health administration. In accordance with Table 3, Cluster 1 shows the

disease profile of chronic multimorbidity, clinical interventions, utilization, and evaluation of health service costs. Conceptually, the characteristics of keywords in these clusters can be grouped into three subdomains:

1. Clinical Profile, Comorbidities, and Patient Vulnerability.

This subdomain is dominated by chronic, systemic, metabolic, and cardiovascular diseases that have high complexity, including: diabetes mellitus, type 2; obesity; hypertension; cardiovascular diseases; heart failure; myocardial infarction; stroke; volume stroke; and HIV infections (Chapman et al., 2022; Zhang et al., 2025). This physical condition is also related to the psychological aspect and vulnerability of the patient, characterized by the emergence of the term depression, as well as special conditions such as pregnancy (Al Salman et al., 2022; Ailes et al., 2023).

2. Combination Medical, Diagnostic, and Pharmacotherapy Interventions

The research in this cluster has largely evaluated patient management through drug intervention and clinical monitoring, which is reflected by the terms: drug therapy, combination; drug combinations; administration, oral; hypoglycemic agents; sodium-glucose transporter 2 inhibitors; glucosides; and benzhydryl compounds (Çakar et al., 2023). In terms of diagnostics and monitoring of disease exacerbation, the terms that appear include magnetic resonance imaging; biomarkers; blood glucose; blood pressure, and hemorrhage (Afonso Rocha et al., 2021; Reka et al., 2025).

3. Evaluation of Clinical Outcomes, Prognosis, and Economic Impact of Hospitals

The third subdomain connects medical administration with hospital management. Evaluation focus is measured through indicators of clinical time and success, such as treatment outcome; quality of life; prognosis; disease progression; recurrence; time factors; and risk assessment (Cutillo et al., 2024; Valentidenta and Pribadi, 2025). These clinical outcomes have a direct impact on indicators of economic efficiency and hospital quality, as indicated by the terms cost-benefit analysis, hospitalization, and severity of illness index (Zhang and Li, 2022; Yu and Zhang, 2025).

Cluster 2 discusses chemotherapy protocols, immunotherapy, and the evaluation of cancer patients' prognosis. The main keywords in this cluster include types of malignancies such as breast neoplasms, colorectal neoplasms, and ovarian neoplasms (Hwang et al., 2024; Reka et al., 2025). Interventions focused on current treatments such as neoadjuvant therapy, paclitaxel, as well as monoclonal antibody-based targeted therapy (antibodies, monoclonal dan antibodies, monoclonal, humanized)(Shay et al., 2021; Simmons et al., 2025). The evaluation of the final results of the research is measured through macro clinical indicators such as progression-free survival, disease progression, prognosis, neoplasm recurrence, local and disease-free survival (Shay et al., 2021; Çakar et al., 2023). One of the most interesting findings of Cluster 2 is its very recent publication year. The average publication for all members in this cluster is in the range of the end of 2022 to the beginning of 2024. In fact, the keyword progression-free survival has an average publication year score of 2024,382. This indicates that the efficacy evaluation of the latest cancer therapies (especially monoclonal antibody target therapies) is the hottest topic or research trend that is currently being published (Santero et al., 2024; Shirota et al., 2024).

Cluster 3 analysis focused on cellular target therapy and characteristics of antineoplastic substances in lung cancer. Cluster 3 is closely related to Cluster 2, but is more specific to the treatment of lung cancer (carcinoma, non-small-cell lung, and lung neoplasms)(Çakar et al., 2023). This cluster specifically discusses the treatment of lung cancer driven by genetic mutations with protein kinase inhibitors, as well as the structures of the chemical compounds that comprise these inhibitors (Shay et al., 2021). This cluster is also characterized by keywords related to cellular biomonitoring, such as mutations, treatment with small-molecule inhibitors (protein kinase inhibitors), and specific chemical compounds, including pyrazoles, pyridines, and pyrimidines (Rischke, Kanbach and Haug, 2024; Shimomura et al., 2024). In addition to the dose-response relationship (drug) effectiveness, the safety aspect is the main concern in this cluster (Çakar et al., 2023; Santero et al., 2024). Therapy with pyrimidines, pyrazoles, and protein kinase inhibitors has been intensively researched in the last year or two (Rischke, Kanbach and Haug, 2024; Shimomura et al., 2024).

Cluster 4 is about mitigating the global Covid-19 pandemic, immunogenicity, and vaccination safety. This cluster documents the dynamic response of the medical research community to the impact of a large-scale global health crisis. The keywords in this cluster were identified through the emergence of the virus that causes the crisis, namely SARS-CoV-2, and the name of the pandemic condition, namely covid-19. This literature map records the crucial phase in which all world health service operations were forced to adapt radically to the spread of the virus infection (Liu et al., 2024; Xiang et al., 2025b). Long-term countermeasures through the immune injection program, characterized by the terms vaccination and covid-19 vaccines (Chapman et al., 2022; Ii and Watanabe, 2022). Scientific evaluation in the literature focuses on the level of effectiveness of the body's antibody formation, which is

reflected by the terms immunogenicity, vaccine; antibodies, neutralizing; and antibodies, viral (Wu et al., 2025b). All clinical evaluations are described with the keywords safety, safety aspects, and drug side effects (Zhang and Li, 2022).

Table 3. Summary of bibliographic coupling analysis (cluster composition and keywords)

Cluster and color	Cluster label	Number of keywords	Representative keyword
1 (Red)	Chronic Multimorbidity Disease Profile, Clinical Interventions, Utilization, and Evaluation of Health Service Costs	33	Administration oral, risk assessment, blood pressure, recurrence, prognosis, sodium-glucose transporter 2 inhibitors, hypoglycemic agents, treatment outcome, magnetic resonance imaging, biomarkers, drug combinations, blood glucose, hospitalization, hypertension, drug therapy combination, risk factors, obesity, disease progression, stroke volume, time factors, diabetes mellitus type 2, cardiovascular diseases, heart failure, prevalence, depression, benzhydryl compounds, glucosides, HIV infections, pregnancy, hemorrhage, stroke, cost-benefit analysis, myocardial infarction
2 (Green)	Chemotherapy, Immunotherapy, and Prognosis Evaluation Protocol for Carcinoma Patients	18	progression-free survival, neoplasm staging, piperazines, immune checkpoint inhibitors, immunotherapy, antibodies, monoclonal, antibodies, monoclonal humanized, erb-b2 receptor tyrosine kinases, nivolumab, antineoplastic combined chemotherapy protocols, neoplasm recurrence local, cisplatin, chemotherapy adjuvant, carboplatin, neoadjuvant therapy, ovarian neoplasms, paclitaxel, breast neoplasms
3 (Blue)	Cellular Target Therapy and Characteristics of Antineoplastic Substances in Lung Cancer	11	dose-response relationship drug, pyrazoles, mutation, protein kinase inhibitors, pyrimidines, piperidines, carcinoma non-small-cell lung, lung neoplasms, pyridines, neoplasms, antineoplastic agents
4 (Yellow)	Global Pandemic Mitigation, Immunogenicity, Vaccination Safety	8	Safety, antibodies neutralizing, immunogenicity vaccine, antibodies viral, vaccination, covid-19 vaccines, sars-cov-2, covid-19

Source : PubMed Metadata, analyzed with Excel

Novelty Trend Analysis (Overlay Visualization)

Based on the overlay visualization generated by VOSviewer, the evolution of the development of the global research focus on DRG and the role of the clinical coder shows a clear shift from the left region to the lower right and middle regions of the network map. On the visual map, the clusters on the upper left side containing covid-19, sars-cov-2, and vaccination are dominated by deep purple (Chapman et al., 2022; Ii and Watanabe, 2022). This indicates that the topic of global health crisis response is a widely researched trend in the early phase (mid-2023). On the lower left side, acute clinical conditions such as stroke, heart failure, and hemorrhage are also dark blue, suggesting that the mapping of the underlying disease burden is on the same timeline (Afonso Rocha et al., 2021; Chapman et al., 2022).

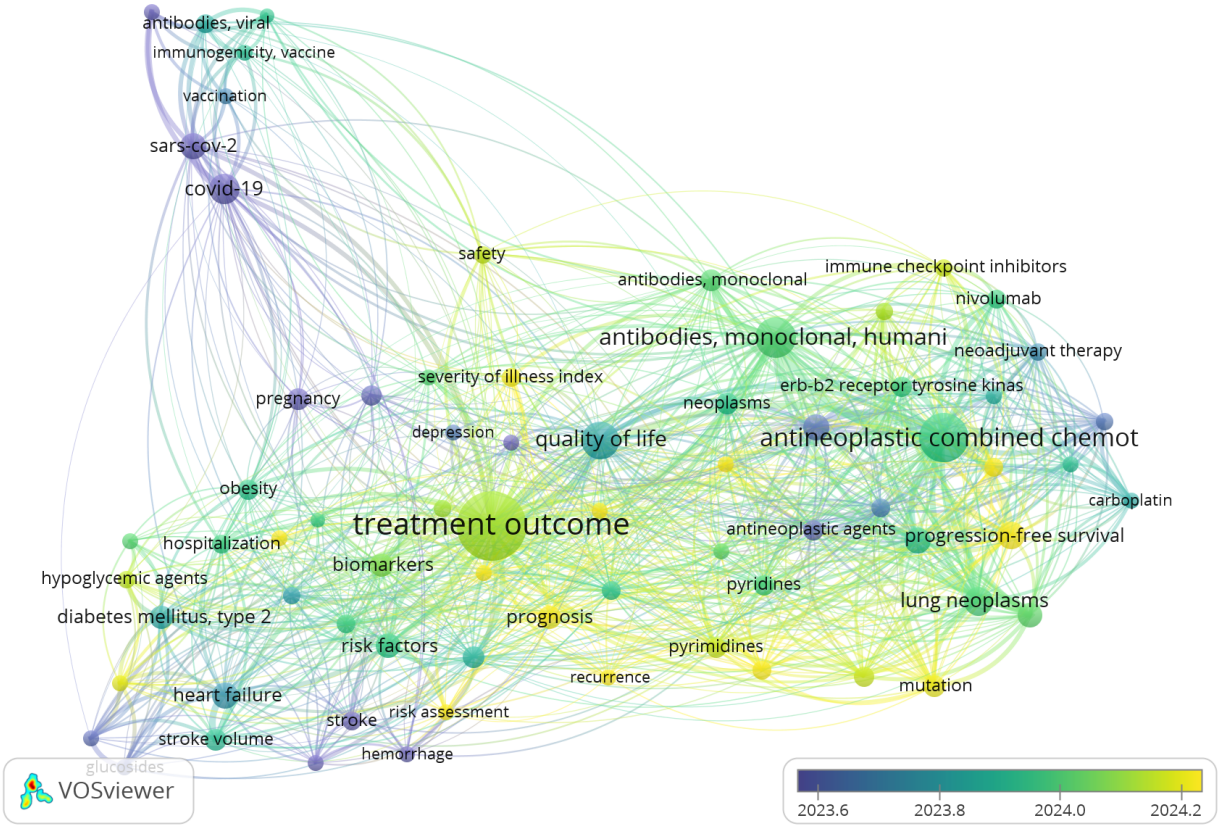

Figure 3. DRG Overlay Visualization Depicts Research Topic Trends
Source : Vosviewer Data

Entering the transition phase (late 2023), the visual map began to be dominated by green in large central terms such as treatment outcome, quality of life, and antineoplastic combined chemotherapy protocols (Çakar et al., 2023). This indicates that global research during this period focused heavily on standardizing clinical outcomes and evaluating conventional cancer treatment protocols. The peak of novelty in this study is shown by bright yellow knots that light up in several strategic areas, such as in the lower right area for cancer services with a chemotherapy approach. Terms such as mutations, lung neoplasms, progression-free survival, as well as new drug compounds (pyrimidines, pyrazoles) are bright yellow, confirming that precision oncology research is a new topic of current research (Rischke, Kanbach and Haug, 2024; Shimomura et al., 2024). In the middle area, the terms prognosis and recurrence appear, which prove that there has been a shift in the focus of global research from the original short-term curative to the evaluation of long-term therapeutic outcomes (Shay et al., 2021; Çakar et al., 2023).

Theoretical Implication

As the focus of research has expanded from simply curing acute infections to maintaining patients' long-term quality of life, the role of coders has theoretically evolved from a clerical role (automatic data feeder) to an owner of intellectual capital (a strategic knowledge asset). Currently, the world of medicine is shifting from a volume-based paradigm to value-based care and patient quality of life (Du et al., 2025). The outcome of treatment is no longer assessed just from the point of view of the clinician, but is measured comprehensively based on the quality of life that the patient directly feels (Xiang et al., 2024)(Zhang, Qian, et al., 2024). Coders hold a pivotal responsibility in converting clinical documentation from medical records into precise diagnostic and procedural codes. A specific and complete clinical picture of the patient is useful for providing service reimbursement cost claims in accordance with the casemix grouping, thereby maintaining hospital finances in the DRG era (Yu et al., 2024; Fu et al., 2025).

The trend toward modern cancer treatment using immunotherapy or monoclonal antibodies is the largest and most expensive cost driver (Santero et al., 2024; Shirota et al., 2024). This creates a wide gap between the macro policy of health insurance (DRG package tariff) and the micro operations of hospitals (the real cost of patients' drugs

that swell). Coding skills in performing detailed coding (high-granularity coding) are a weapon to ensure that the severity of the patient's disease (severity of illness index) is recorded correctly (Islam et al., 2021; Zhang and Li, 2022; Yu and Zhang, 2025). Coder ensures that all capital costs of expensive cancer treatment and the treatment of catastrophic comorbidities (such as diabetes and cardiovascular disease) are appropriately justified, so that hospitals receive fair and accountable reimbursement (Asadi et al., 2022; Xiang et al., 2025a).

Managerial Implications

The shift in global disease trends that show an increase in catastrophic cases and the use of medical technology and the discovery of expensive new drugs have a real financial impact, thus demanding hospital management to immediately take tactical steps through optimizing the role of clinical coders (Chen et al., 2025; Wu et al., 2025a). Strategic steps that must be taken by hospital management are to tighten the standardization of medical services through the clinical pathway (Wu et al., 2025a). Management is obliged to develop strict clinical service guidelines and hospital formularies to control the variability of medical costs due to the use of new, very expensive molecular drugs, so that real expenses do not hit the upper limit of the DRG flat package tariff (Chen et al., 2025; Hu, Lei and Piao, 2025).

Many physicians do not fully understand how their day-to-day clinical work is directly related to hospital funding and revenue (Smith, Mockeridge and van Zundert, 2022) Complete, clear, and detailed documentation of medical records by physicians contributes to determining the success of the coding process (Carvalho et al., 2021). There is multidisciplinary collaboration by holding discussion sessions between doctor-coder, integrating coding understanding into all stages of medical training, including teaching doctors to write clear diagnoses (Smith, Mockeridge and van Zundert, 2022). This collaboration can avoid miscodes, dig into details of cancer stages, comorbidities, and complications, and report drug side effects to ensure all patient clinical complexities are properly documented (Hosseini et al., 2021; Gabel et al., 2024). With complete documentation, coders can streamline work time because unclear, ambiguous medical records, or the use of non-standard abbreviations force coders to spend a lot of time reviewing the entire patient file to clarify incomplete diagnoses (Carvalho et al., 2021). The accuracy of entering this complication code is vital as valid evidence to justify the surge in service costs to the insurance verifier, so that the hospital claim passes without experiencing a claim dispute (Asadi et al., 2022) .

In the DRG system, hospitals' reimbursement is calculated systematically based on the patient's severity. If there is a gap in, for example, the doctor does not write down the stage in detail, or if the clinical coder is not thorough in entering the complication or comorbid code, then the insurance system will consider the patient to be in the mild category (Saizan et al., 2021). A significant portion of lost hospital revenue is directly attributable to poor clinical documentation, where a retrospective study proved that code omissions due to incomplete medical records have the potential to trigger losses of up to $22,680,584 USD in one year (Gabel et al., 2024). In specific units such as anesthesia, the neglect of important details, such as obesity, intraoperative hypotension, or postoperative nausea and vomiting, proved fatal as it led to a contrasting difference in reimbursement value reduction of between $5,000 to $17,000 AUD per case (Smith, Mockeridge and van Zundert, 2022). This phenomenon of under-coding affects underpayment, which causes hospitals to incur greater financial losses because the real treatment of patients is higher than the sum insured paid by insurance (Saizan et al., 2021; Leland et al., 2026).

Hospital health insurance management must change the way the Case-Mix Team works, from a reactive approach at the end of the month to a proactive team that moves in real time (Hosseini et al., 2021; Khorrami et al., 2022; Yu et al., 2024). The function of the clinical coder must be elevated from an ordinary clerical administrative officer to a part of the hospital's financial risk management (strategic defense). Hospitals are advised to implement a special daily medical record audit function (pre-verification coding) for complex, catastrophic cases (such as oncology and cardiology) (Asadi et al., 2022). Building harmonious, structured two-way communication between doctors and coders is the most effective managerial strategy to fairly secure hospital revenue and prevent the risk of claim denial (Gabel et al., 2024).

To ensure that all claims governance strategies run sustainably, hospital management is obliged to strengthen human capital for technical implementers. Frequent problems, such as the complexity of the classification system (many ICD coding rules), lack of coding experience, lack of clinical knowledge, and subjectivity in coding, can lead to a decrease in coding quality (Carvalho et al., 2021). This concrete step must begin with continuous capacity building through structured training. Clinical coders need to be equipped with in-depth knowledge of DRG payment patterns and improve coding skills to be able to translate complex medical records accurately (Asadi et al., 2022; Jahromi, 2024) In addition to strengthening competencies, management must also calculate workload objectively (Yu et al., 2024). Excessive coder workload due to an unbalanced claim file ratio has proven to be a major trigger

for high burnout rates, which has a direct impact on reduced accuracy and increased risk of fatal errors, such as under-coding (Yu et al., 2024; Wang et al., 2026). Given the role of the coder as a determinant of hospital revenue, the provision of a fair and performance-based remuneration and incentive scheme will not only increase their work motivation, but also mitigate the risk of moral hazard and ensure that the coder can work at optimal performance to protect the hospital from the threat of financial deficit (Carvalho et al., 2021).

CONCLUSION

This bibliometric study concludes that there is a strong causal relationship between the complexity of global clinical interventions and hospital financial stability. The role of the clinical coder in the modern health insurance system is a pillar in strategic financial risk management, not just an administrative function. The accuracy of codifying high-cost diagnoses and procedures is the main determinant of the Severity of Illness Index and the value of hospital reimbursement. Optimizing coders' ongoing competencies and integrating coordination with the Case-Mix Team are crucial to protecting hospitals from the threat of operational financial deficits.

STRENGTHS AND LIMITATIONS

The core merit of this study lies in the use of a combined bibliometric method that integrates the visualization capabilities of VOSviewer with objective quantitative metric analysis in Excel. The use of large-scale datasets (4,280 documents) from PubMed guarantees the high validity of the global health governance trends analyzed. However, this study has limitations due to database bias, as the search is limited to a single database (PubMed). Language restrictions on English-only articles can also prevent relevant scientific publications from appearing in local journals in developing countries. This study is chiefly limited by its reliance on PubMed, which does not consistently provide structured data on the country of origin for the research. These technical limitations prevent the research from mapping the geographical distribution and collaboration networks between countries related to DRG research and clinical coding.

RECOMMENDATIONS FOR FURTHER RESEARCH

Future research is suggested to expand the scope of metadata extraction by integrating other international databases, such as Scopus and the Web of Science. Researchers will then need to conduct a macro-scale comparative study of the impact of the ICD-11 transition on the accuracy of DRG package tariffs across various developing countries. The development of an evaluation model based on artificial intelligence to support the automated codification audit process is also a promising new research domain.

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