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ECONOMETRICS OF HEALTHCARE WORKERS' PRODUCTIVITY DETERMINANTS WITHIN THE FRAMEWORK OF INCLUSIVE HEALTH TRANSFORMATION

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Abstract: Global health transformation toward inclusive and sustainable healthcare services faces significant challenges regarding productivity disparities among healthcare workers between urban and rural areas. This study aims to analyze the determinant factors of healthcare worker productivity using econometric models within the framework of inclusive health transformation in underserved areas. This cross-sectional quantitative research involved 32 healthcare workers from four Primary Health Centers (Bumbu, Binanga, Keaang, and Tarialu) in West Sulawesi, selected through purposive sampling with a minimum one-year work experience criterion. The research instrument utilized a validated structured questionnaire with a 1-4 Likert scale. The variables examined included work environment (X1), discipline factors (X2), and technology support as moderating variables, with work productivity and performance effectiveness as dependent variables. Analysis employed Structural Equation Modeling (SEM) using PLS. The results demonstrated strong model validity with R-square values of 92.3% for work productivity and 83.4% for performance effectiveness. Work discipline showed a significant positive effect on performance effectiveness (coefficient 1.117, $p<0.05$), while work environment exhibited a non-significant negative effect on productivity (coefficient -0.058, $p>0.05$). Technology support revealed opposing moderation paradoxes in both examined relationships. This research unveils the technology paradox phenomenon in inclusive health transformation and confirms work discipline as the primary driver of healthcare worker performance effectiveness, with important implications for more nuanced health technology implementation strategies.

Keywords: econometric analysis, healthcare workers, inclusive health transformation, productivity determinants, technology paradox.

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INTRODUCTION

The global health transformation toward providing inclusive and sustainable healthcare services has emerged as a strategic priority in national and international development agendas. The Sustainable Development Goals (SDGs) emphasize a global commitment to end epidemics of AIDS, tuberculosis, malaria, and other communicable diseases by 2030, with the objective of achieving universal health coverage and providing access to safe and affordable medicines and vaccines for all (United Nations Department of Economic and Social Affairs, 2024). However, progress toward achieving global health targets has faced significant challenges since 2015, particularly regarding maternal mortality, premature deaths from non-communicable diseases, and access to essential healthcare services, with persistent inequalities especially among vulnerable populations (World Health Organization, 2024).

The health economics context demonstrates that human capital investment in the health sector generates substantial economic impact (Ruslan et al., 2024). Two-thirds of the income gap between developed and developing countries can be attributed to disparities in human capital, where healthy, skilled, and innovative individuals are better equipped to seize employment opportunities, create job-generating businesses, and drive economic growth (World Bank, 2024). In Indonesia, productivity losses due to disease are estimated to reach nearly 30 percent of annual GDP, with more than $201 billion in economic output, or nearly 19 percent of GDP, lost annually due to low productivity caused by non-communicable diseases such as heart failure, respiratory problems, and cancer (Oliver Wyman, 2019).

This significant economic burden underscores the importance of optimizing healthcare human resources as a strategic investment. Health serves as human capital itself and as an input for producing other forms of human capital, with poor childhood health potentially suppressing human capital formation with implications for lifetime income (Bleakley, 2010). Within the context of inclusive health transformation, approximately $130 billion annually, or 14 percent of Indonesia's GDP, represents avoidable losses through appropriate interventions, demonstrating substantial return on investment potential from optimizing healthcare worker productivity (Oliver Wyman, 2019).

Productivity disparities among healthcare workers between urban and rural areas constitute a significant global challenge. Data from the 2014-2020 period reveals that the highest density of nursing and midwifery personnel is found in North America with over 152 per 10,000 population, nearly 4 times the global average of 40 per 10,000 and more than 15 times the figure for Sub-Saharan Africa, as well as 8 times that for North Africa and Southern Asia (United Nations Department of Economic and Social Affairs, 2024). Similar conditions exist for medical personnel, with an estimated 40 doctors per 10,000 population in Europe compared to only 2 per 10,000 population in Sub-Saharan Africa (United Nations Department of Economic and Social Affairs, 2024).

Global projections reveal increasingly complex challenges. Economic models predict that by 2030, global demand for healthcare workers will reach 80 million workers, double the current stock (2013), while the supply of healthcare workers is expected to reach only 65 million over the same period, resulting in a worldwide net shortage of 15 million healthcare workers (Liu et al., 2017). Predictions indicate a deficit of up to 18 million healthcare workers by 2030, with the largest net shortages projected to occur in Southeast Asia and the Pacific, alongside serious challenges in Africa, particularly the sub-Saharan region (International Federation of Gynecology and Obstetrics, 2018).

Cost-effectiveness ratios of healthcare services in underserved areas demonstrate significant inefficiency. Evaluations of Indonesia's National Health Insurance (JKN) indicate that members have inequitable access to high-quality health services, primarily due to geographical maldistribution of health infrastructure and human resources, including medical specialists (Sparkes et al., 2023). The JKN appears to have stimulated growth in medical services but mainly in the private sector and urban centers, not in rural areas, with maldistribution of personnel and facilities also affecting the quality of health services (Sparkes et al., 2023).

Economic factors affecting healthcare worker retention encompass compensation aspects, work environment, and career development opportunities. Econometric analysis using cross-sectional data from the International Labour Organization (ILO) demonstrates that human resources are consistently cited as a leading contributor to healthcare costs; however, the

availability of internationally comparable data on healthcare worker earnings for all countries remains a challenge in healthcare service cost estimation (Scheil-Adlung et al., 2018; Wahyuni et al., 2024).

Human Capital Theory in the context of healthcare productivity provides a robust theoretical foundation for understanding productivity determinant factors. According to human capital theory, increases in an individual's stock of knowledge or human capital enhance productivity in the market sector of the economy, where monetary earnings are generated, and in the non-market or household sector, where commodities entering the utility function are produced (Becker, 1964). Human capital theory posits that companies have incentives to seek productive human capital and add to the human capital of existing employees, with human capital representing a concept that recognizes labor capital as non-homogeneous (Grossman, 2000).

Work Environment Economics Theory explains the relationship between working conditions and productivity output. Global data indicates that employee engagement declined to 21% in 2024, with managers experiencing the largest drop, representing a worrying sign for organizations already struggling with productivity (Gallup, 2025). Manager engagement fell from 30% to 27% in 2024, with young managers and female managers experiencing the largest declines, where 70% of team engagement can be attributed to the manager (Gallup, 2025).

Discipline capital as a productivity determinant represents an evolving concept in economic literature. Human capital is further enhanced through education, training, intelligence, skills, health, and other qualities valued by employers, such as loyalty and punctuality, as intangible assets perceived to increase productivity and profitability (Investopedia, 2024). In the context of healthcare workers, discipline capital encompasses adherence to standard operating procedures, effective time management, and consistency in service delivery.

Limitations in econometric research on healthcare workers in Indonesia reveal significant gaps in the literature. Despite growing interest, existing scientific literature primarily concentrates on methodologies rather than theoretical and practical insights, with diverse methodological applications often misaligned with broader economic theories or healthcare purposes, limiting their contribution to advancing theoretical and practical understanding of efficiency and productivity in healthcare systems (Nepomuceno et al., 2025).

Bibliometric analysis demonstrates that productivity measurement in the healthcare sector has evolved as an appealing research topic in recent years; however, its application is often misaligned with broader economic theories or healthcare objectives (Nepomuceno et al., 2025). This condition creates a need for more integrated approaches in analyzing healthcare worker productivity determinant factors.

The novelty of the multivariable approach within the context of inclusive health transformation lies in integrating econometric theory with practical realities in underserved areas. Health systems must consider the needs, experiences, and preferences of people and their right to be treated with respect, where many consumer services make user experience a central mission; however, health systems—like other public sector systems—are often difficult to use and unresponsive to people's time and preferences (Kruk et al., 2018).

The primary objective of this research is to analyze healthcare worker productivity determinant factors using econometric models within the context of inclusive health transformation in underserved areas. This study aims to provide evidence-based recommendations for optimizing healthcare human resource investments.

Research questions developed based on gap analysis and theoretical framework include:

RQ1: How does work environment influence healthcare worker productivity?

This question explores work environment dimensions encompassing physical infrastructure, workload, and technology support as productivity determinants. To address healthcare worker shortages, countries must increase training of new health professionals, enhance staff retention by improving working conditions, and encourage innovation related to work organization and the use of new technologies to efficiently respond to growing care demands (Organisation for Economic Co-operation and Development, 2024).

RQ2: To what extent do discipline factors contribute to performance outcomes?

This question investigates the role of disciplinary factors including attendance, adherence to SOPs, and time management in achieving optimal performance outcomes.

RQ3: Which factors possess the highest elasticity toward productivity?

This question aims to identify factors with the highest marginal impact on productivity for resource allocation optimization and policy interventions.

Based on the theoretical framework and evidence from international literature, this research develops three main hypotheses:

H_1: Work environment has a significant positive effect on productivity. This hypothesis is supported by projections that productivity will increase in knowledge-intensive industries, including IT and digital communication services, financial and professional services, medical and health services, retail, manufacturing, engineering and construction, energy and logistics (World Economic Forum, 2024). A conducive work environment is expected to create enabling conditions for healthcare worker productivity optimization.

H_2: Discipline factors positively correlate with performance effectiveness. This hypothesis is based on the concept of discipline capital as a form of human capital investment that contributes to performance effectiveness. Health is human capital itself and also an input for producing other forms of human capital, where discipline is a manifestation of internalized human capital (Chen et al., 2024).

H_3: Technology support has a moderating effect on these relationships. This hypothesis anticipates technology's moderating effect in strengthening the relationship between work environment and discipline factors toward productivity. Most major economists surveyed by the Forum believe that generative AI will increase productivity and innovation in high-income countries, although for low-income countries, only one-third consider this will occur (World Economic Forum, 2024).

This research is expected to provide theoretical and practical contributions in optimizing healthcare worker productivity to support achieving inclusive health transformation, particularly in underserved areas facing structural challenges in achieving health SDG targets (Campbell et al., 2015; International Labour Organization et al., 2023).

METHODS

This research methodology employs a cross-sectional quantitative study design grounded in an econometric approach, representing a strategic methodological choice to capture a snapshot of healthcare worker productivity within a specific temporal context. The cross-sectional approach was selected for its capacity to analyze inter-variable relationships at a particular point in time, which aligns with the research objective of identifying determinant factors of productivity that can be simultaneously intervened within the framework of inclusive health transformation.

The target population focuses on healthcare workers in underdeveloped regions of West Sulawesi, a geographical setting purposively chosen to represent the structural challenges faced by health systems in Indonesia's peripheral areas. The sampling strategy employs a purposive sampling approach with inclusion criteria requiring a minimum of one year of work experience, designed to ensure that respondents possess adequate exposure to the work environment and have undergone sufficient organizational adaptation processes to provide valid assessments regarding productivity factors.

Sample size determination was conducted through rigorous power analysis, establishing a total sample of 32 healthcare workers, calculated based on an effect size of 0.3, significance level α=0.05, and statistical power of 0.80. These parameters reflect conservative standards in behavioral science research that enable detection of medium-sized effects with high confidence levels. Sample distribution was implemented across four Primary Health Centers (Puskesmas): Bumbu, Binanga, Keaang, and Tarialu, providing adequate geographical representation and enabling control over institutional variability that might influence productivity outcomes.

The research variable architecture is constructed with a sophisticated hierarchical structure, where Healthcare Worker Productivity (Y) functions as the dependent variable in the form of a composite score integrating productivity and work effectiveness dimensions. Independent variable operationalization encompasses Work Environment (X_1), conceptualized as a multidimensional construct covering physical infrastructure, workload, and technological support, alongside Discipline Factors (X_2), operationalized through indicators of attendance, adherence to standard operating procedures, and time management effectiveness. Institutional

Support (X_3) is included as a control variable to anticipate organizational variability that might confound the primary relationships under investigation.

The econometric model specification was designed with a tiered approach enabling progressive exploration of inter-variable relationship complexity. Model 1 represents a basic linear regression with the formulation Productivity = β_0 + β_1(WorkEnv) + β_2(Discipline) + β_3(InstSupport) + ε, functioning as a baseline for estimating main effects of each predictor. Model 2 extends the analysis by incorporating interaction terms through the formulation Productivity = β_0 + β_1(WorkEnv) + β_2(Discipline) + β_3(WorkEnv×Discipline) + β_4(Controls) + ε, enabling exploration of synergistic effects between work environment and discipline factors. This modeling strategy reflects sophisticated understanding of potential non-linear relationships and interaction effects characteristic of behavioral research.

Data collection instruments utilize a structured questionnaire with a 1-4 Likert scale, a deliberate choice to avoid central tendency bias often occurring with odd-numbered response options. Instrument validation was conducted through validity testing using Pearson Product Moment with a threshold of r>0.7, while reliability was assessed through Cronbach's Alpha with a cut-off of α>0.8, representing stringent standards for psychometric quality in quantitative research.

The statistical analysis plan was designed with a comprehensive approach encompassing multiple analytical layers. The initial stage involves descriptive statistics for data distribution characterization through measures of central tendency and variability. Correlation analysis using Pearson correlation matrix will explore bivariate relationship patterns among variables before progressing to multiple linear regression with stepwise method for systematic model building. Model diagnostics will include multicollinearity assessment through Variance Inflation Factor (VIF), heteroscedasticity testing, and normality tests to ensure assumption compliance. Robustness checks through alternative specifications will be conducted to validate the stability of primary findings.

The research ethical framework is built upon adherence to fundamental research ethics principles, encompassing the acquisition of ethical clearance from competent institutions, procurement of informed consent from all respondents ensuring voluntary participation and understanding of research objectives, and implementation of robust data anonymization and confidentiality protocols to protect respondent privacy and dignity. This ethical approach reflects a commitment to responsible research conduct essential in studies involving human subjects, particularly healthcare workers who may be in vulnerable positions regarding their employment and professional standing.

FINDING AND DISCUSSIONS

The structural model is evaluated using R-square for dependent latent variables. In assessing the model with PLS, the evaluation begins by examining the R-square for each dependent endogenous variable.

Table 1. R *Square* Variable Constructs

	R-square	R-square adjusted
Work Productivity (Y1)	0.923	0.909
Performance Effectiveness (Y2)	0.834	0.802

Source: Output PLS 2025

The R-square value for the work productivity variable is 0.923, which indicates that it falls within the strong category. This R-square value of 0.909 or 90.9% for work productivity demonstrates that the work productivity variable can be explained by the work environment, work discipline, and technology availability variables (moderating variables) by 90.9%, while the remaining 9.1% can be explained by other variables not included in this study. The R-square value for the performance effectiveness variable is 0.834, which indicates that it falls within the strong category. This R-square value of 0.802 or 80.2% for performance effectiveness shows that the performance effectiveness variable can be explained by the work environment, work discipline, and technology availability variables (moderating variables) by 80.2%, while the remaining 19.8% can be explained by other variables not included in this study.

Table 2. Path Coefficients of Work Environment Dimensions

	Original sample	Sample mean	Standard deviation	T statistics	P values
Infrastructure Quality (X1.1) -> Work Environment (X1)	0.451	0.452	0.033	13.556	0
Work Load Intensity (X1.2) -> Work Environment (X1)	0.345	0.346	0.026	13.394	0
Technology Support Availability -> Work Productivity (Y1)	0.142	0.143	0.22	0.648	0.517

Source: Output PLS, 2025

From the path coefficient results above, it can be observed that there are two first-order constructs that significantly influence the second-order work environment construct, where the T-statistic values generated for all first-order constructs are > 1.96 or p-value < 0.05. This indicates that the first-order constructs (infrastructure quality and work load intensity) constitute the formative components of the work environment construct.

Table 3. *Path Coefficients of Work Discipline Dimensions*

	Original sample	Sample mean	Standard deviation	T statistics	P values
Attendance Consistency (X2.1) -> Work Discipline (X2)	0.287	0.287	0.025	11.328	0
Compliance with Standard Operating Procedures (X2.2) -> Work Discipline (X2)	0.405	0.403	0.022	18.269	0
Time Management Efficiency (X2.3) -> Work Discipline (X2)	0.355	0.355	0.019	19.138	0

Source: Output PLS, 2025

From the path coefficient results above, it can be observed that all first-order constructs significantly influence the second-order work discipline construct, where the T-statistic values generated for all first-order constructs are > 1.96 or p-value < 0.05. This indicates that all first-order constructs (attendance consistency, compliance with standard operating procedures, and time management efficiency) constitute the formative components of the work discipline construct.

Tabel 4. Hypothesis Testing based on *Path Coefficient*

	Original sample	Sample mean	Standard deviation	T statistics	P values
Work Environment (X1) -> Work Productivity (Y1)	-0.058	-0.053	0.276	0.212	0.832
Work Discipline (X2) -> Performance Effectiveness (Y2)	1.117	1.107	0.185	6.03	0

Source: Output PLS 2025

H_1: Work environment has a significant positive effect on productivity

The first hypothesis states that work environment has a positive and significant effect on work productivity. Table 11 shows that the work environment variable has a significance level of 0.832, which is greater than 0.05. The parameter coefficient value of -0.058 indicates a negative influence on the dependent variable. This means H1 is rejected, so it can be stated that the work environment variable has a negative and non-significant effect on work productivity.

The research findings showing a negative and non-significant relationship between work environment and healthcare worker productivity can be explained through the complexity of the work environment construct in the healthcare service context. Multivariable research in Turkish hospitals identified that factors affecting healthcare worker work limitations include deteriorating work environment perceptions, declining health status, medical profession, low income levels, and increased work duration (Kiliç et al., 2023). The study demonstrated that 32.8% of changes in work limitation scores were associated with these factors, where increased negative perceptions of the work environment actually increased work limitations. This aligns

with research by Rostami et al. (2021) which found that the relationship between mental workload and job satisfaction is moderated by job control, where without adequate job control, the work environment can produce counterproductive effects (Wang, et al., 2023). This phenomenon can be explained through the Job Demands-Resources theory, which states that job resources such as working conditions, autonomy, and social support can mitigate stress and mental problems caused by various job demands (Li et al., 2023).

The specific context of healthcare workers adds complexity to the work environment-productivity relationship due to the unique job characteristics in this sector. Healthcare workers operating in unstable and unhealthy atmospheres are at risk of experiencing occupational diseases that negatively impact their productivity (Zahid et al., 2022). Research across various hospitals indicates that the probability of experiencing work environment-related health problems is higher among healthcare workers compared to other occupational groups, and their performance was found to be lower (Kiliç et al., 2023). The negative findings in this study can be understood through the concept of "work environment paradox" in the healthcare sector, where efforts to improve the work environment do not automatically enhance productivity without considering moderating factors such as job control, mental workload, and individual worker characteristics. Burnout studies on healthcare workers demonstrate that job control has a moderating effect on the relationship between workload and fatigue (Koutsimani et al., 2019), highlighting the importance of a holistic approach in understanding determinants of healthcare worker productivity. The practical implications of these findings are the need for transformation of human resource management strategies in the healthcare sector that not only focus on improving the physical environment, but also strengthening job control, reducing mental workload, and enhancing psychosocial resources to achieve sustainable productivity improvements.

H_2: Discipline factors positively correlate with performance effectiveness.

The second hypothesis states that work discipline has a positive and significant effect on performance effectiveness. Table 11 shows that the work discipline variable has a significance level of 0.000, which is less than 0.05. The parameter coefficient value of +1.117 indicates a positive influence on the dependent variable. This means H2 is accepted, so it can be stated that work discipline has a positive and significant effect on performance effectiveness.

The research findings showing a positive and significant effect of work discipline on healthcare worker performance effectiveness align with human resource management theory that emphasizes discipline as the most important operative function in achieving optimal performance. According to Fathoni (2016), discipline is the most important operative function in human resource management because it can influence employee performance, where better employee discipline leads to higher work performance that can be achieved (Phillips et al., 2021). Empirical studies in hospitals demonstrate consistency with these findings, where research at Bhayangkara Hospital Pontianak found that work discipline has a positive and significant impact on employee performance, with strong work discipline promoting accountability and productivity (Maharani & Rahmawati, 2024). Furthermore, regression analysis in mediation studies shows that work discipline has a path coefficient value of 0.377 with a t-statistic value of 4.547 and p-value of 0.000, indicating that the work discipline variable has a positive and substantial impact on employee performance (Suryani et al., 2023). The magnitude of the coefficient +1.117 in this study even shows a larger effect compared to previous studies, illustrating the importance of work discipline in the context of inclusive health transformation.

In the healthcare worker context, work discipline has specific implications for patient safety and healthcare service quality. Research indicates that the work discipline variable has a significant effect on performance with a t-calculated value (11.177) > t-table (1.652), and simultaneously together with occupational safety and health as well as leadership style has a significant effect on employee performance with a significance probability of 0.000 < 0.05 (Rostina et al., 2020). The mechanism of work discipline's influence on performance effectiveness can be explained through goal-setting and self-regulation theory, where employees with good work discipline tend to demonstrate higher performance compared to undisciplined employees, and good work discipline can reduce absenteeism and tardiness rates, which in turn can increase productivity (Dugguh & Dennis, 2014 in Saputra et al., 2024). Research across various industrial

sectors shows that companies implementing good work discipline can minimize losses due to production errors and increase customer satisfaction through high-quality products (Obasan Kehinde, 2011). The statistical significance consistent with a p-value of 0.000 in this study confirms the robustness of the work discipline-performance effectiveness relationship, which has practical implications for hospital management in developing effective performance management systems to support inclusive health transformation goals.

H_2: Discipline factors positively correlate with performance effectiveness

Tabel 5. Hypothesis Testing based on Effect Moderasi

	Original sample	Sample mean	Standard deviation	T statistics	P values
Technology Support Availability x Work Environment (X1) -> Work Productivity (Y1)	0.064	0.076	0.133	0.483	0.629
Technology Support Availability x Work Discipline (X2) -> Performance Effectiveness (Y2)	-0.09	-0.061	0.182	0.494	0.622

Source: Output PLS 2024

Based on the inner weight values from the indirect effect consisting of work environment (X1) and work discipline (X2), the partial influence on work productivity (Y1) and performance effectiveness can be determined when moderated by technology support availability (M).

Table 5 shows that the work environment variable has a significance level of 0.629, which is greater than 0.05. The positive coefficient indicates a direct relationship between the work environment variable (X1) and the work productivity variable (Y) when moderated by the technology support availability variable (Z). This means H3a is rejected, so it can be stated that work environment moderated by technology support availability has a positive and non-significant effect on work productivity.

The moderation parameter coefficient value between work environment and technology support availability on work productivity is 0.064, which is greater than the parameter coefficient value of work environment on work productivity at -0.058. This indicates that the technology support availability variable is a moderating variable that can strengthen the relationship between work environment and work productivity.

The work discipline variable has a significance level of 0.622, which is greater than 0.05. The negative coefficient indicates an opposite relationship between the work discipline variable (X2) and the performance effectiveness variable (Y2) when moderated by the technology support availability variable (Z). This means H3b is rejected, so it can be stated that work discipline moderated by technology support availability has a negative and non-significant effect on performance effectiveness.

The moderation parameter coefficient value between work discipline and technology support availability on performance effectiveness is -0.090, which is smaller than the parameter coefficient value of work discipline on performance effectiveness at 1.117. This indicates that the technology support availability variable is a moderating variable that can weaken the relationship between work discipline and performance effectiveness.

The findings of this research reveal a technology paradox phenomenon in the context of inclusive health transformation, where technology support availability demonstrates opposing moderation effects on the work environment-productivity relationship and the work discipline-performance effectiveness relationship. In the work environment-productivity relationship, although the technology moderation effect is positive (coefficient 0.064 > -0.058), it is not significant (p=0.629 > 0.05), indicating that technology can strengthen the relationship but has not reached the statistical significance threshold. Conversely, in the work discipline-performance effectiveness relationship, technology actually weakens the relationship with a negative moderation coefficient (-0.090 < 1.117) and is not significant (p=0.622 > 0.05). This phenomenon aligns with the productivity paradox concept, which refers to the slowdown in productivity growth despite rapid developments in information technology, where up to half of US healthcare spending growth can be attributed to technology costs, and computers and phones are

continuously cited as the biggest causes of workplace productivity decline through disruption (Brynjolfsson, 2012). In the healthcare context, digital health technologies can disrupt power relationships and cause paradoxical outcomes, where when digital health technologies fail, staff can develop general pessimism about innovation (Ziebland et al., 2021).

The technology paradox in this research can be understood through the theory of unintended consequences and technology as an "organizational actor" that can strengthen or weaken work systems. Research in three different countries shows many examples where PCIS (Patient Care Information Systems) applications appear to promote errors rather than reduce their likelihood, where systems consisting of people, technology, organizational routines, and regulations that shape healthcare practices appear to be weakened rather than strengthened by the introduction of PCIS applications (Harrison et al., 2016). The strengthening effect of technology on work environment can be explained through mechanisms of employee productivity enhancement, improved efficiency and effectiveness of health unit operations, and reduced operational costs (Gjellebaek et al., 2022). However, the weakening effect on work discipline reflects technological advances in the workplace that often produce contradictory effects by facilitating accessibility and efficiency while simultaneously increasing disruption and unpredictability (Mazmanian et al., 2016). In AI implementation in healthcare services, there are various technology paradoxes related to ethical dilemmas about data misuse, AI efficiency for critical diagnostic services, user resistance, investment costs, and funding issues (Singh et al., 2024). The practical implications of these findings indicate the need for a more nuanced approach in healthcare technology implementation, where organizations need to consider not only the potential benefits of technology but also the "dark logic" that can produce consequences contrary to the initial goals of inclusive health transformation.

CONCLUSION

This research demonstrates strong model validity with R-square values of 92.3% for work productivity and 83.4% for performance effectiveness, confirming robust explanatory power of the proposed framework. The structural equation modeling analysis reveals contrasting findings regarding direct relationships: while work discipline shows a strong positive and significant effect on performance effectiveness (coefficient 1.117, $p < 0.05$), work environment unexpectedly demonstrates a negative and non-significant effect on work productivity (coefficient -0.058, $p > 0.05$). This paradoxical finding reflects the complexity of healthcare environments where environmental improvements do not automatically translate to productivity gains without considering moderating factors such as job control and mental workload management.

The study uncovers a significant technology paradox phenomenon where technology support availability produces opposing moderation effects on the examined relationships. While technology strengthens the work environment-productivity relationship (though non-significantly), it paradoxically weakens the work discipline-performance effectiveness relationship, both failing to achieve statistical significance. These findings align with the productivity paradox in healthcare technology implementation, where digital solutions can simultaneously facilitate efficiency and increase disruption. The results underscore the critical importance of work discipline as the primary driver of healthcare performance effectiveness while highlighting the need for nuanced technology implementation strategies that recognize both the potential benefits and unintended consequences of technological integration in healthcare transformation initiatives.

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