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EVALUATION OF THE EFFECTIVENESS OF HEALTHCARE PROFESSIONALS' PROFESSIONAL DEVELOPMENT BASED ON ROI AND DIGITAL KPIS

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Abstract. A comprehensive approach to assessing the effectiveness of professional development for healthcare workers at educational, practical, economic, systemic, and digital levels has been developed. Based on the integration of the Donabedian, Kirkpatrick, and ROI methodologies, an analytical model for Uzbekistan covering 2020–2026 has been developed. The indicators for 2020–2024 are interpreted as an analytical series, while the values for 2025–2026 are treated as a scenario-based forecast. The results demonstrate positive dynamics in ROI, successful course completion, digital platform activity, reduction in medical errors, and the use of artificial intelligence (AI) tools.

Keywords: healthcare professional development, ROI, digital KPI, human capital, SEIQR, efficiency, artificial intelligence, Uzbekistan.

Annotatsiya. Tibbiyot xodimlari malakasini oshirish samaradorligini o'quv, amaliy, iqtisodiy, tizimli va raqamli darajalarda baholashga qaratilgan kompleks yondashuv ishlab chiqilgan. Donabedian, Kirkpatrick va ROI metodologiyalarining integratsiyasi asosida O'zbekiston uchun 2020–2026-yillarni qamrab oluvchi analitik model shakllantirilgan. 2020–2024-yillardagi ko'rsatkichlar analitik qator sifatida, 2025–2026-yillardagi qiymatlar esa ssenariyli prognoz sifatida talqin qilingan. Tahlil natijalari ROI darajasi, kurslarni muvaffaqiyatli yakunlash, raqamli platformalardagi faollik, tibbiy xatolarni kamaytirish hamda sun'iy intellekt (SI) vositalaridan foydalanish ko'rsatkichlarida ijobiy dinamika mavjudligini ko'rsatgan.

Kalit so'zlar: tibbiyot xodimlari malakasini oshirish, ROI, raqamli KPI, inson kapitali, SEIQR, samaradorlik, sun'iy intellekt, O'zbekiston.

Аннотация. Разработан комплексный подход к оценке эффективности повышения квалификации медицинских работников на образовательном, практическом, экономическом, системном и цифровом уровнях. На основе интеграции методологий Донабедиана, Киркпатрика и ROI сформирована аналитическая модель для Узбекистана, охватывающая 2020–2026 годы. Показатели за 2020–2024 годы интерпретированы как аналитический ряд, а значения за 2025–2026 годы — как сценарный прогноз. Результаты анализа свидетельствуют о положительной динамике показателей ROI, успешного завершения курсов, активности на цифровых платформах, снижения количества медицинских ошибок и использования инструментов искусственного интеллекта (ИИ).

Ключевые слова: повышение квалификации медицинских работников, ROI, цифровые KPI, человеческий капитал, SEIQR, эффективность, искусственный интеллект, Узбекистан.

INTRODUCTION

Professional development of healthcare professionals is an investment in human capital that determines the quality of healthcare, patient safety, and the productivity of the healthcare sector. In the context of digital healthcare, assessing educational outcomes solely based on test scores or the number of certificates is insufficient. The transfer of acquired knowledge into clinical practice, reduction of errors, cost savings, and engagement with digital platforms should also be taken into account.

Donabedian's "structure–process–outcome" model enables a systematic assessment of quality.¹ The Kirkpatrick model, in turn, distinguishes between reaction, learning, behavior, and organizational outcomes.² Presidential Decree No. PF-6079 of October 5, 2020, "On Approval of the Digital Uzbekistan — 2030 Strategy and Measures

¹ Donabedian A. The Quality of Care: How Can It Be Assessed? // JAMA. 1988. Vol. 260(12). P. 1743–1748.

² Kirkpatrick D., Kirkpatrick J. Evaluating Training Programs. 3rd ed. San Francisco: Berrett-Koehler, 2006. P. 21–61.

for Its Effective Implementation³ Presidential Decree No. PF-88 of May 19, 2025, “On Measures to Consistently Continue the Reform of the Sector by Improving the Healthcare System and the Principles of Providing Medical Services to the Population”;⁴ and Presidential Resolution No. PQ-185 of May 19, 2025, “On Additional Measures for the Implementation of Reforms in the Healthcare System”⁵ set out objectives for the modernization of digital infrastructure and healthcare services. In domestic research, digital competencies are interpreted as a qualitative component of human capital.⁶

The purpose of this study is to comprehensively evaluate the effectiveness of professional development for healthcare professionals using ROI and digital KPIs and to develop a dynamic model for Uzbekistan covering the period 2020–2026.

LITERATURE REVIEW

In the scientific literature on evaluating the effectiveness of professional development for healthcare professionals, the integration of quality, educational outcomes, and economic returns is considered a priority area. A. Donabedian proposed evaluating the quality of healthcare services through the “structure–process–outcome” sequence, interpreting workforce capacity and infrastructure as structure, educational and clinical activities as process, and changes in patient safety and service quality as outcomes.⁷ This approach provides a methodological basis for examining professional development not as an isolated educational activity, but as a systemic factor contributing to the improvement of clinical quality.

D. Kirkpatrick and J. Kirkpatrick evaluate training effectiveness at the levels of reaction, learning, behavior, and organizational outcomes. The advantage of the model lies in its consistent linkage of participants’ satisfaction with the course to knowledge acquisition, the application of acquired competencies in the workplace, and organizational outcomes. To expand the model’s capacity for assessing economic efficiency, it is important to consider the ratio between costs and monetized benefits as an independent indicator. J. J. Phillips and P. P. Phillips further developed this aspect through the ROI approach, recommending that program costs be subtracted from program benefits and that the resulting value be expressed as a percentage relative to the costs.⁸

In the context of digital transformation, there is a growing need to incorporate KPIs such as platform activity, course completion, the use of digital content, data security, and the application of artificial intelligence tools into traditional assessment models. The OECD emphasizes the importance of integrating healthcare professionals’ digital competencies into initial and continuing education programs and aligning leadership and organizational changes with technological advancements.⁹ The World Health Organization’s *Global Strategy on Digital Health* links the effectiveness of digital systems to the coordinated development of governance, human capital, interoperability, and reliable data infrastructure.¹⁰

Research conducted in Uzbekistan considers digital competencies as a qualitative component of human capital and a factor contributing to increased labor productivity. M. A. Mutalova substantiates the importance of the continuous development of competencies, individualized learning trajectories, and enhanced digital assessment mechanisms in the context of the digital economy.¹¹ Domestic scientific and practical materials devoted to human capital development also highlight the relationship between investments in knowledge and skills, economic growth, and institutional efficiency.¹² Presidential Decree No. PF-6079 of October 5, 2020, “On Approval of the Digital Uzbekistan — 2030 Strategy and Measures for Its Effective Implementation”;¹³ Fa Presidential Decree No. PF-88 of May 19, 2025, “On Measures to Consistently Continue the Reform of the Sector by Improving the Healthcare System

3 Decree of the President of the Republic of Uzbekistan No. PF-6079 dated October 5, 2020, “On Approval of the Digital Uzbekistan — 2030 Strategy and Measures for Its Effective Implementation.”: <https://lex.uz/ru/docs/-5030957>

4 Decree of the President of the Republic of Uzbekistan No. PF-88 dated May 19, 2025, “On Measures to Consistently Continue Reforms by Improving the Healthcare System and the Principles of Providing Medical Services to the Population in the Republic.”: <https://lex.uz/uz/docs/-7534275>

5 Resolution of the President of the Republic of Uzbekistan No. PQ-185 dated May 19, 2025, “On Additional Measures for Implementing Reforms in the Healthcare System.”: <https://lex.uz/docs/-7538083>

6 Mutalova M.A. Raqamli iqtisodiyot sharoitida inson kapitalining raqamli kompetensiyalarini rivojlantirish strategiyalari // TDIU konferensiya materiallari. Toshkent, 2025. 233–237-betlar.

7 Donabedian A. The Quality of Care: How Can It Be Assessed? // JAMA. 1988. Vol. 260(12). P. 1743–1748.

8 Phillips J.J., Phillips P.P. Show Me the Money: How to Determine ROI in People, Projects, and Programs. San Francisco: Berrett-Koehler, 2007. P. 25–52.

9 OECD. Empowering the Health Workforce to Make the Most of the Digital Revolution. OECD Health Working Paper No. 129. Paris, 2021. P. 33–36, 49–53.

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11 Mutalova M.A. Raqamli iqtisodiyot sharoitida inson kapitalining raqamli kompetensiyalarini rivojlantirish strategiyalari // TDIU konferensiya materiallari. Toshkent, 2025. 233–237-b.

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13 Decree of the President of the Republic of Uzbekistan No. PF-6079 dated October 5, 2020, “On Approval of the Digital Uzbekistan — 2030 Strategy and Measures for Its Effective Implementation.”: <https://lex.uz/ru/docs/-5030957>

and the Principles of Providing Medical Services to the Population”;¹⁴ and Presidential Resolution No. PQ-185 of May 19, 2025, “On Additional Measures for the Implementation of Reforms in the Healthcare System”¹⁵ establish digitalization objectives that form the national institutional foundation for these scientific approaches.¹⁶

The literature review demonstrates that further development of opportunities for integrating quality, learning outcomes, economic returns, and digital competencies within existing approaches is appropriate. In the professional development of healthcare professionals, integrating the Donabedian, Kirkpatrick, and Phillips models into a unified system and evaluating ROI results alongside digital KPIs and clinical indicators over the 2020–2026 period can contribute to the further advancement of scientific approaches in this field. Therefore, the scientific position of this study is based on integrating educational, practical, economic, systemic, and digital dimensions of effectiveness within a unified comprehensive assessment mechanism.

RESEARCH METHODOLOGY

The study was conducted using a descriptive-analytical and scenario-based research design. The period 2020–2024 was considered as an author-developed analytical series, while the period 2025–2026 was treated as a forecast based on trend and target scenarios. The data were not presented as official national statistics but were generated as calibrated model values to demonstrate the proposed assessment mechanism.

Integral effectiveness was expressed using the formula $E_i = \alpha E_{\text{educational}} + \beta E_{\text{practical}} + \gamma E_{\text{economic}} + \delta E_{\text{systemic}} + \varepsilon E_{\text{digital}}$, where the sum of the weights equals 1. Economic efficiency was calculated using the formula $ROI = (B - C) / C \times 100\%$, where **B** represents the total monetized benefits and **C** represents the cost of professional development. Digital monitoring employed indicators such as course completion, knowledge improvement, reduction in errors, platform activity, and the independent use of AI tools.

ANALYSIS AND RESULTS

ROI and Cost–Benefit Dynamics

Table 1

Economic Indicators of Professional Development in Uzbekistan, 2020–2026¹⁷

Year	Cost, thousand UZS	Total Benefit, thousand UZS	ROI, %
2020	950	1,031	8.5
2021	1,080	1,190	10.2
2022	1,240	1,390	12.1
2023	1,500	1,746	16.4
2024	1,890	2,291	21.2
2025*	2,180	2,786	27.8
2026*	2,470	3,322	34.5

The table data indicate that the economic efficiency of investments in professional development increased consistently during 2020–2026. In particular, while expenditures are projected to rise from UZS 950 thousand in 2020 to UZS 2,470 thousand in 2026, total benefits are expected to increase from UZS 1,031 thousand to UZS 3,322 thousand over the same period. As a result, the ROI is projected to increase from 8.5% to 34.5%, reflecting a year-by-year improvement in the economic return on funds invested in professional development (Figure 1).

14 Decree of the President of the Republic of Uzbekistan No. PF-88 dated May 19, 2025, “On Measures to Consistently Continue Reforms by Improving the Healthcare System and the Principles of Providing Medical Services to the Population in the Republic.”: <https://lex.uz/uz/docs/-7534275>

15 Resolution of the President of the Republic of Uzbekistan No. PQ-185 dated May 19, 2025, “On Additional Measures for Implementing Reforms in the Healthcare System.”: <https://lex.uz/docs/-7538083>

16 Lex.uz.

17 Source: Author’s calculations. 2025–2026 — forecast

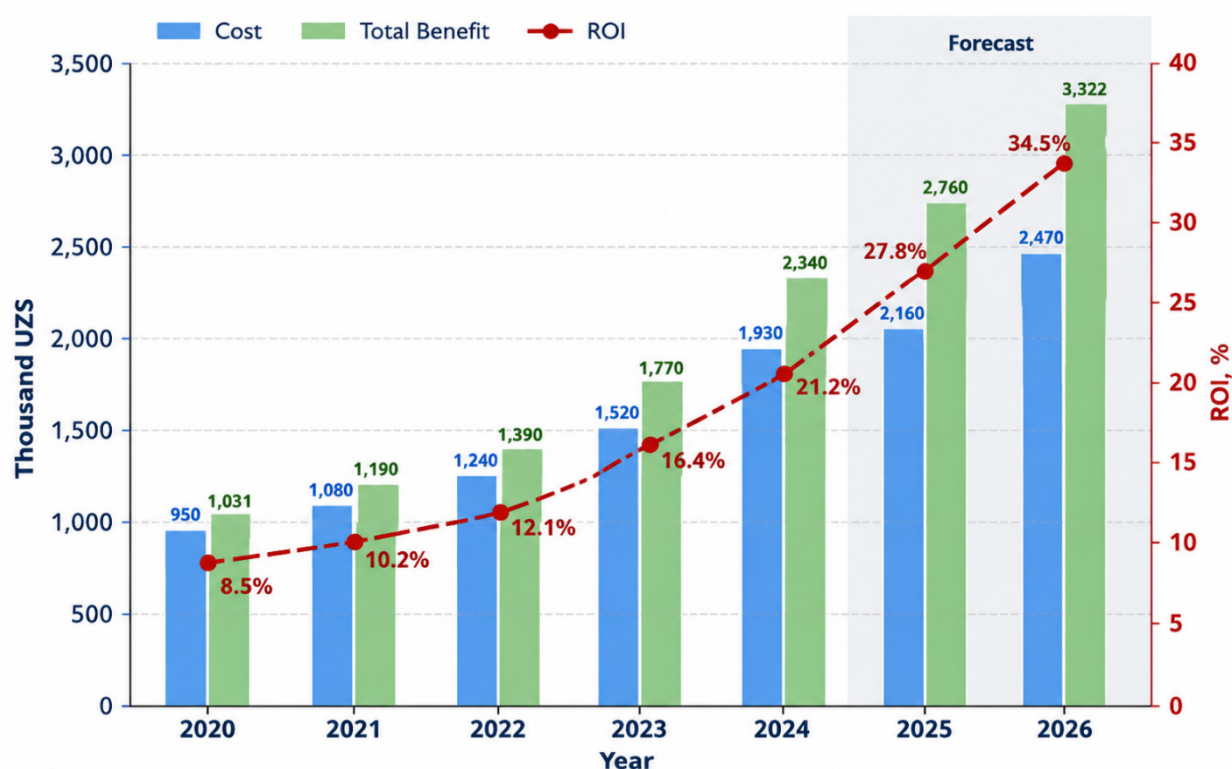


Figure 1. ROI Dynamics of Investments in Professional Development¹⁸

The ROI dynamics show a particularly pronounced acceleration in growth starting from 2023. While the indicator stood at 16.4% in 2023, it increased to 21.2% in 2024 and is projected to reach 27.8% in 2025 and 34.5% in 2026. This trend demonstrates that, alongside the increase in professional development expenditures, the economic benefits generated from these investments are growing at a relatively faster rate.

According to the Uzbekistan model, ROI increased from 8.5% in 2020 to 21.2% in 2024. Under the baseline scenario, this indicator is projected to reach 34.5% by 2026. The international scenario for the digital system demonstrates faster growth compared with the traditional model because the marginal cost of delivering previously developed digital content to additional learners decreases, while real-time monitoring enables the early detection of errors.

Digital KPI Dynamics

Table 2

Key KPIs of Continuing Medical Education, 2020–2026 (%)¹⁹

Year	Course Completion	Error Reduction	Platform Activity	AI Tools
2020	58	5	18	2
2021	63	9	27	5
2022	69	14	39	10
2023	75	21	52	18
2024	81	29	66	31
2025	87	36	78	47
2026	91	42	87	62

¹⁸ Source: Author's analytical model; 2025–2026 figures are forecasts

¹⁹ Source: Author's calculations; 2025–2026 figures are forecasts. AI tools refer to the share of independent use.

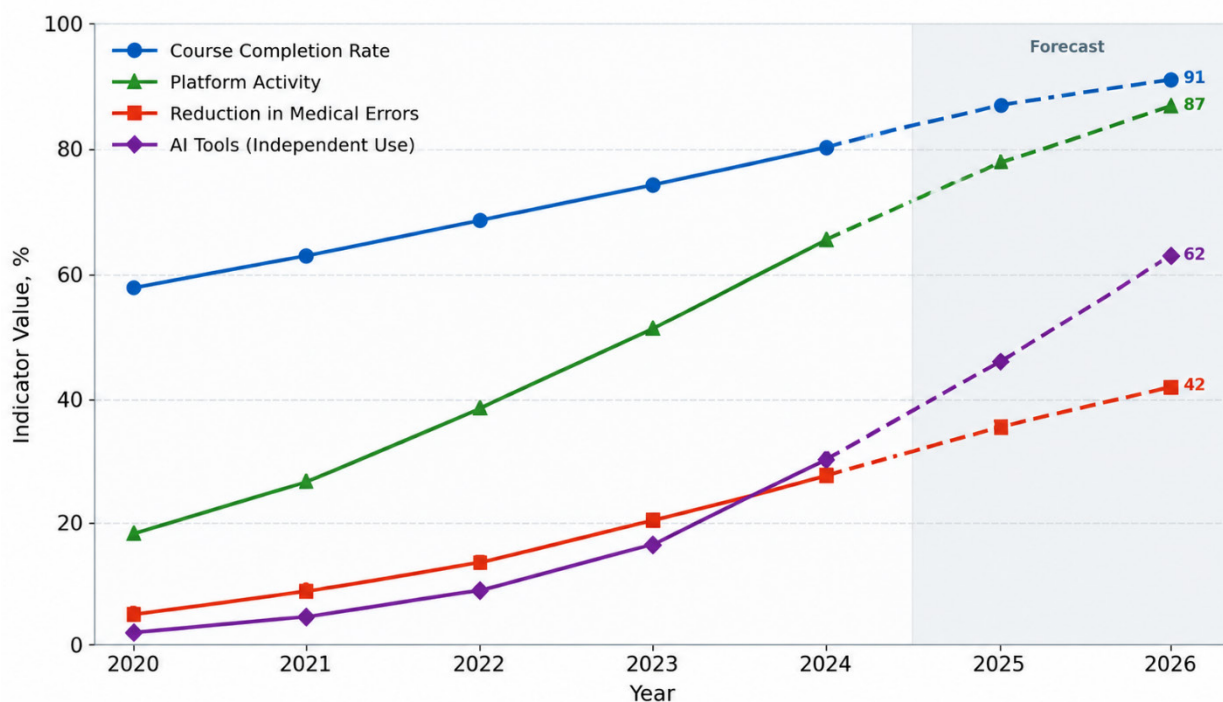


Figure 2. Dynamics of Digital KPIs²⁰

The course completion rate is expected to increase from 58% to 91%, while platform activity is projected to rise from 18% to 87%. The indicator reflecting the reduction in medical errors reached 29% in 2024 and is projected to reach 42% under the 2026 scenario. Increasing the share of independent and safe use of AI tools from 2% in 2020 to 62% in 2026 represents an important institutional priority.

The results indicate that measuring the effectiveness of professional development solely through learning outcomes does not fully capture ROI and clinical benefits. According to the Phillips methodology, monetized benefits should be compared with costs.²¹ However, in medical education, outcomes that cannot be fully expressed in monetary terms, such as patient safety, professional competence, and social benefits, should also be maintained as separate KPIs.

The OECD recommends integrating digital health competencies into the core educational curriculum.²² The World Health Organization (WHO) associates digital transformation with the integrated development of technology, governance, and workforce capacity.²³ In the context of Uzbekistan, integrating the KPI system with “Electronic Health” platforms could facilitate a transition from annual certification to a continuous monitoring system.

The research findings are based on an analytical model. To further improve the accuracy of the forecasts, it is advisable to recalibrate the model annually using administrative data and to separately account for the effects of other organizational and technological factors when calculating ROI.

CONCLUSION AND RECOMMENDATIONS

The research findings demonstrate the appropriateness of comprehensively evaluating the effectiveness of continuing professional development for healthcare professionals based on ROI and digital KPIs. According to the analytical model, ROI increased from 8.5% in 2020 to 21.2% in 2024 and is projected to reach 34.5% by 2026. Over the same period, the course completion rate is expected to increase from 58% to 91%, platform activity from 18% to 87%, and the share of independent use of AI tools from 2% to 62%. These results confirm that a digital professional development system can simultaneously improve economic efficiency, learning engagement, and practical competencies.

In practice, it is recommended to introduce a unified digital KPI profile that integrates pre-test and post-test results, electronic portfolios, simulation assessments, clinical error monitoring, platform activity, and ROI indicators.

20 Source: Developed by the author.

21 Phillips J.J., Phillips P.P. Show Me the Money: How to Determine ROI in People, Projects, and Programs. San Francisco: Berrett-Koehler, 2007. P. 25–52.

22 OECD. Empowering the Health Workforce to Make the Most of the Digital Revolution. OECD Health Working Paper No. 129. Paris, 2021. P. 33–36, 49–53.

23 World Health Organization. Global Strategy on Digital Health 2020–2025. Geneva: WHO, 2021. P. 12–18, 31–36.

Integrating these data with “Electronic Health” systems would make it possible to identify individual professional development needs and facilitate timely management decision-making. It is also advisable to incorporate modules on artificial intelligence, cybersecurity, digital medicine, and digital ethics into training programs.

Since the indicators for 2025–2026 are scenario-based forecasts, they should be regularly updated using actual administrative data. Future research should test the proposed model across regions, healthcare institutions, and medical specialties, as well as assess clinical outcomes and long-term economic effects. Consequently, the mechanism based on ROI and digital KPIs can facilitate the management of professional development expenditures as investments aimed at strengthening human capital and improving the quality of healthcare services.

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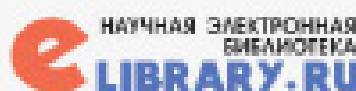
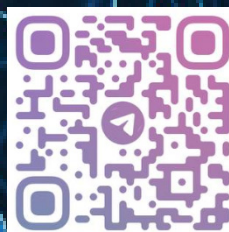
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