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DEVELOPMENT AND IMPLEMENTATION OF THE PRESENTMED DIGITAL PLATFORM FOR END-TO-END PATIENT ROUTING IN COLOPROCTOLOGY

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Abstract. This study presents a pilot implementation of the PresentMed digital platform designed for end-to-end patient routing in coloproctology. The platform integrates outpatient, inpatient and telemedicine services into a unified digital ecosystem, enabling electronic medical records, standardized clinical pathways, remote consultations and real-time analytical monitoring. During implementation (630 patients across multiple regions of Uzbekistan), significant improvements were recorded, including reduced diagnostic delays, fewer uncoordinated referrals, increased use of telemedicine consultations and higher compliance with clinical protocols. Clinical outcomes also improved: rates of early diagnosis increased, access to advanced diagnostic procedures expanded and the need for surgical interventions was nearly halved. Patient satisfaction and treatment adherence demonstrated measurable growth. These findings confirm the effectiveness of the integrated digital model and highlight its potential for broader scaling within specialized care.
Keywords: digital platform; patient routing; coloproctology; telemedicine; electronic medical records; integrated care model; early diagnosis.

Introduction

Coloproctological disorders constitute a highly prevalent group of conditions that exert a considerable impact on public health indicators and population productivity. Contemporary care models built around outpatient-centered management, telemedicine and digital patient routing have demonstrated their value in accelerating diagnostic processes, improving service accessibility and enhancing clinical outcomes [1; 2].

For health systems undergoing modernization-such as Uzbekistan's-adapting leading international practices to local realities remains a pressing objective. Although proctological diseases are widespread and significantly affect patients' quality of life and ability to work, the coloproctology service often occupies a secondary position within the national healthcare agenda. Limited specialist availability, fragmented patient pathways and delays in establishing a diagnosis contribute to a higher rate of complications and an increased need for urgent

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surgical intervention. These challenges underscore the need for new conceptual frameworks rooted in continuity of care, accessibility and personalized patient management.

The ongoing digital transformation of healthcare provides powerful tools for addressing these systemic constraints. As several authors argue, medical digitalization is not merely the deployment of isolated electronic services but a profound restructuring of interactions among patients, physicians and healthcare institutions [3; 4]. Telemedicine, in particular, has shown strong effectiveness in settings characterized by geographical dispersion and workforce shortages: for instance, during the COVID-19 pandemic, remote consultations ensured continuous follow-up for proctology patients across multiple regions. Growing consensus among experts suggests that telemedicine is especially appropriate in coloproctology for surveillance, multidisciplinary coordination and follow-up care, provided that initial assessment of complex cases continues to rely on in-person examination [5].

This study introduces a digital platform for coordinated patient routing aimed at synchronizing outpatient and inpatient stages of coloproctology care. Its effectiveness is evaluated from the perspectives of accessibility, timeliness and overall coordination of medical services.

Methods

A prospective pilot study was carried out to develop a digital information system and introduce it into routine coloproctology practice, followed by an assessment of medical, statistical and socio-economic indicators. The resulting platform, named *PresentMed*, was designed to create an end-to-end digital continuum covering all stages of patient management-from initial consultation and diagnostic work-up to inpatient treatment, telemedicine consultations and longitudinal follow-up. Core system requirements included modularity (stepwise functional expansion), analytical capability (collection and visualization of key performance indicators), integration of telemedicine (remote consultations and interregional boards), and scalability for institutions of different levels.

The architecture of PresentMed follows a client–server model using modern web technologies to ensure high reliability and performance. The platform is organized into several modules, including:

1. *Scheduling*: tools for appointment management synchronized with the patient registry to prevent duplication.
2. *Electronic Medical Records (EMR):* secure storage of clinical data, test results and treatment recommendations.
3. *Communication*: an integrated messenger for clinicians and support staff.
4. *Analytics*: real-time dashboards for monitoring visits, diagnoses and KPI metrics with ICD-10 integration.
5. *Audit*: quality-control tools for protocol adherence, documentation completeness, departmental performance and event logging.
6. *Telemedicine*: secure video consultations and interregional case conferences with the exchange of diagnostic materials.
7. *Specialized modules*: within the pilot program, a dedicated Coloproctology module was implemented, featuring digital clinical scales (Wexner, Mayo), structured checklists, histopathology workflows and postoperative monitoring tools.

A strong emphasis was placed on information security and regulatory compliance. Multi-layer protection mechanisms were applied, including JWT-based authentication, role-based access control, TLS encryption, CORS restrictions and comprehensive activity logging. Telemedicine sessions incorporated identity verification and digitally documented informed consent. The

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system was aligned with national data-protection requirements as well as international standards such as ISO/IEC 27001 and GDPR principles.

Pilot implementation of PresentMed was conducted between 2020 and 2025 across multiple regions of Uzbekistan, spanning both metropolitan and peripheral settings. A total of 630 patients received coloproctology care through the digital model. Medical personnel underwent structured training before deployment. Validated evaluation instruments were used: VAS for patient satisfaction, PACIC for care engagement, the Morisky–Green scale for adherence and EQ-5D for quality of life. Clinical indicators included the proportion of early diagnoses, hospitalization rates, complication frequency and access to advanced diagnostic procedures (endoscopy, biopsy, fecal calprotectin and others). Pre-post comparisons were performed using χ^2, Student's t-test, Fisher's exact test and 95% confidence intervals. Statistical processing was carried out in SPSS v26 and R (v4.2), with significance defined as $p < 0.05$.

Results

The development and integration of the PresentMed platform enabled the formation of a unified information and management environment for the coloproctology service. Following pilot implementation, all stages of the patient pathway-from outpatient visits to hospitalization and subsequent follow-up-were connected through a single digital system. This integration ensured full transparency and traceability of routing, eliminated duplicated diagnostic procedures and accelerated information exchange between specialists. Clinicians gained shared access to patient data through a unified electronic medical record and online case discussions, while administrators obtained real-time tools for monitoring quality indicators and operational performance. The quantitative findings below reflect the platform's impact on organizational workflows, clinical outcomes and patient-reported measures.

As illustrated in Figure 1, the introduction of PresentMed substantially accelerated patient routing. The average time from initial presentation to the establishment of a definitive diagnosis decreased from approximately 3–4 days to 1–2 days, representing nearly a two-fold reduction. This improvement was driven by immediate sharing of diagnostic results, remote multidisciplinary consultations and automated reminders for follow-up appointments. The proportion of uncoordinated referrals-cases in which patients were initially directed to the wrong specialist or followed an incorrect diagnostic sequence-declined by 40%, largely due to the implementation of standardized electronic referral pathways that minimized routing errors and redundant examinations.

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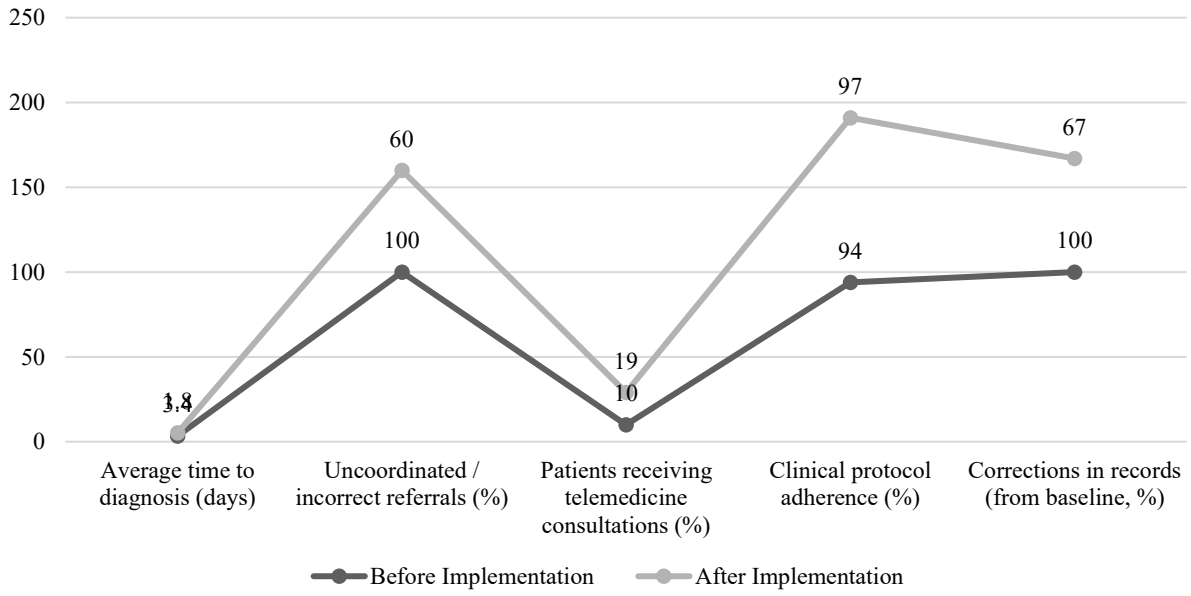
Use of telemedicine increased markedly. Whereas remote consultations were previously sporadic, the proportion of patients receiving at least one online consultation rose by approximately 1.9 times after platform deployment. Video-based multidisciplinary boards between regional facilities and national-level experts became particularly valuable, enhancing access to highly qualified care for patients living in remote districts and reducing the need for unnecessary travel.

Figure 1. Key patient-routing indicators before and after the implementation of the digital platform

Digital transformation of workflow processes also led to measurable improvements in documentation quality. Automated completeness checks and embedded reminders within the



electronic medical record increased adherence to clinical protocols from 94% to 97%. The volume of corrections and addenda-used as an indirect marker of initial incompleteness or documentation errors-decreased by more than one-third. According to the Audit module, administrative errors such as missed diagnostic referrals or incorrectly issued appointment tickets were also reduced. Workload distribution across physicians became more balanced: prior to the platform's introduction, several specialists were consistently overloaded while others had excess capacity, whereas after implementation the average utilization rate aligned at approximately 78% of the maximum. In practical terms, the electronic scheduling system and KPI-based monitoring contributed to more efficient use of clinical resources and optimization of appointment flows.

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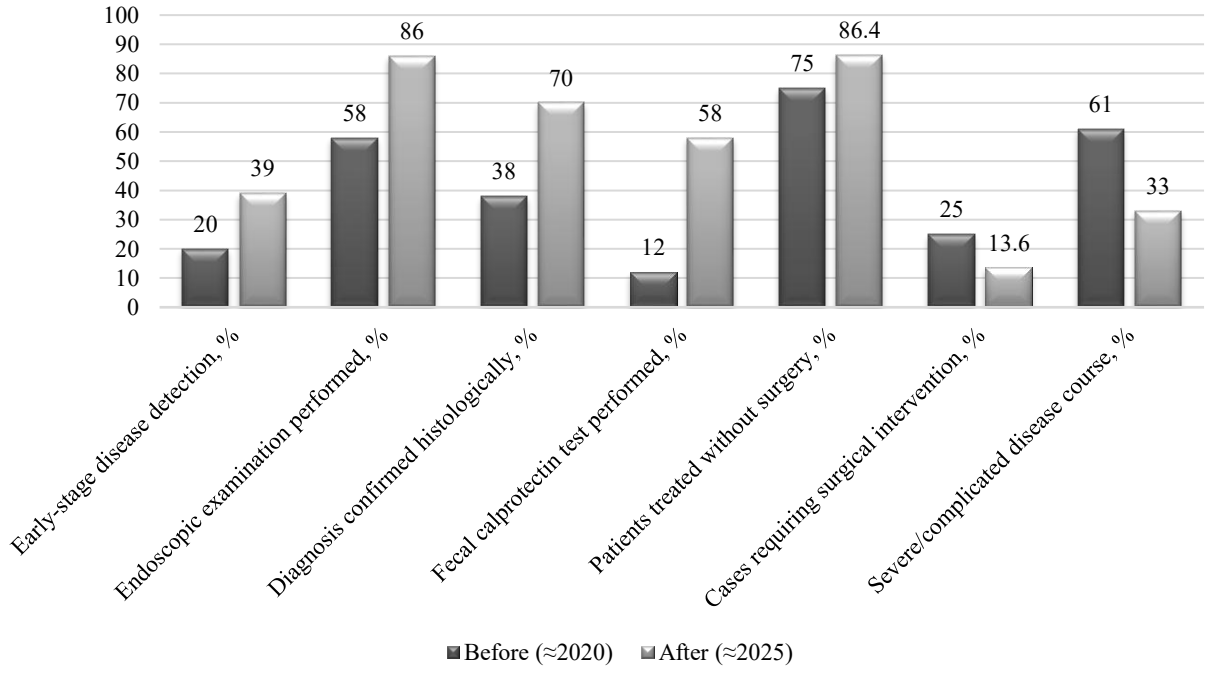
Alongside organizational improvements, the integrated model-anchored by the PresentMed platform-produced clinically significant gains in patient outcomes. Early disease detection increased notably, and the proportion of severe presentations declined. In pilot regions, the rate of early identification (stages I–II) rose from roughly 20% to about 39%. In Tashkent, early-stage detection increased from ~22% to 41.2%, while regional centers demonstrated growth from ~18% to ~37%. These shifts indicate that, under the new model, nearly one in three to four patients received a timely diagnosis, whereas previously this threshold was reached by only one in five. The main drivers of improved early detection included standardized diagnostic algorithms, broader adoption of screening tools (e.g., fecal calprotectin testing) and strengthened endoscopic infrastructure.

Figure 2. Dynamics of selected clinical indicators before and after implementation of the integrated model

Significant progress was also observed in the use of modern diagnostic modalities (see Fig. 2). Endoscopic examination coverage increased from 58% to 86%, histological verification of diagnoses (biopsy with pathology confirmation) rose from 38% to 70%, and utilization of fecal calprotectin testing expanded from 12% to 58%. All changes were statistically significant ($p < 0.001$), reflecting a more comprehensive and evidence-based diagnostic pathway. A clear example of improved diagnostic accuracy is the increase in confirmed cases of ulcerative colitis-from 46% to 74% ($p < 0.001$)-underscoring the influence of the integrated care model



on diagnostic precision.

Following the introduction of the new care model, demand for hospitalization and surgical intervention decreased substantially. Planned hospital admissions for coloproctology patients dropped by approximately 30–35%, driven by more active outpatient management and timely responses to disease exacerbations. The proportion of patients requiring surgical treatment declined from 25% to 13.6%, representing an almost 45% relative reduction. These findings highlight a shift toward stronger therapeutic management and prevention of complications:

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earlier initiation of pharmacologic therapy and closer clinical monitoring enabled stabilization of many severe cases without surgery. Use of modern immunosuppressive and biologic agents increased, resulting in a 1.4-fold prolongation of remission periods and a 27% reduction in relapse frequency. Simultaneously, the number of patients treated entirely on an outpatient basis increased 1.6 times, easing the burden on inpatient services.

A marked decline in emergency and complicated presentations was also observed. Previously, 61% of patients presenting with acute conditions required prolonged hospitalization and faced a high risk of complications. After the organizational redesign, this figure decreased to 33%, indicating stronger disease control and more rapid intervention at early signs of deterioration.

The reforms also produced a measurable socio-economic impact. According to cost analysis, the integrated model reduced direct healthcare expenditures by more than 39% per 1,000 patients, primarily due to fewer hospitalizations and surgeries. The resulting savings-approximately 3.86 billion UZS per 1,000 patients-create opportunities for reinvestment into infrastructure, equipment and workforce development. In this sense, digital patient routing combined with organizational restructuring not only improved clinical outcomes but also increased the overall efficiency of resource utilization.

Table 1. Indicators of patient satisfaction, service accessibility and engagement (2020 vs. 2025)

Indicator (Instrument)	2020	2025	Δ (points)	p-value
Satisfaction with care, VAS score (0–10)	4.2±1.1	7.3±1.0	3.1	<0.0001
Access to targeted consultation, % (PACIC)	36	71	+35 p.p.	<0.001
Patient participation in decisions, % (PACIC)	18	62	+44 p.p.	<0.001
Awareness of team-based care, % (PACIC)	12	55	+43 p.p.	<0.001
High treatment adherence, % of patients	32	69	+37 p.p.	<0.001

Within the pilot project, particular attention was given to patient perceptions of the care they received. Survey results demonstrated a substantial increase in satisfaction following the transition to the new integrated model (see Table 1). Mean satisfaction on the Visual Analogue Scale (0–10) rose from 4.2±1.1 in 2020 to 7.3±1.0 in 2025 ($p < 0.0001$). Respondents highlighted faster organization of care, improved communication with physicians and greater comfort during visits, all of which contributed to stronger trust in the treatment process.

The PACIC survey (Patient Assessment of Chronic Illness Care) revealed a marked shift toward a more patient-oriented system. By 2025, 71% of participants reported timely access to a relevant specialist when needed, compared with 36% in 2020. The proportion of patients who actively participated in decisions regarding their treatment increased from 18% to 62%. Awareness of the multidisciplinary nature of care also improved: the share of patients who understood that their condition was being managed by a coordinated clinical team rose from 12% to 55%. These differences were statistically significant ($p < 0.001$) and indicate the emergence of a more patient-centered model in which individuals feel more informed, involved and supported. As a result, patient engagement in collaborative care increased by two- to three-fold, together with enhanced confidence in personalized medical services.

A particularly important outcome was the improvement in treatment adherence. According to the Morisky Medication Adherence Scale, only 32% of patients in 2020 consistently followed all prescribed recommendations, whereas by 2025 this proportion had risen to 69% ($\chi^2 = 28.6$; $p < 0.001$). The percentage of patients who reported forgetting to take their medication dropped from 61% to 29%, and the proportion of those who discontinued therapy on their own when

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symptoms subsided decreased from 51% to 19%. Overall, the prevalence of low adherence more than halved. Contributing factors included the implementation of "Patient Schools" and a system of personalized digital reminders and follow-up messages delivered through the platform. These tools provided continuous education and reinforced healthy medication habits. Improved adherence, in turn, was directly associated with longer remission periods and fewer disease exacerbations.

The rise in satisfaction, engagement and adherence observed in this study aligns with findings from international research. Telemedicine is widely recognized for its positive influence on patient perceptions of care quality. For instance, in the study by Passannanti and Giovanardi, remote monitoring of postoperative proctology patients via WhatsApp led to significantly higher perceived safety and quality of follow-up management (patients reported improved postoperative care, OR = 4.06; p = 0.01) [6]. Our results echo these conclusions: integrating digital communication and monitoring strengthened feedback loops with patients and enhanced their confidence in the treatment process.

Discussion

Implementation of the digital patient-routing platform, combined with organizational restructuring, resulted in a marked improvement in the efficiency of coloproctology services. Integrating outpatient, inpatient and remote care into a unified information environment substantially accelerated the diagnostic–therapeutic pathway: the average time to diagnosis was reduced by nearly half, and episodes of uncoordinated referrals were practically eliminated. These findings are consistent with international literature demonstrating that digital triage systems and telemedicine-based coordination reduce delays in access to specialty care, including documented examples of gastroenterology triage in other healthcare systems [7].

Enhanced coordination among primary care physicians, outpatient specialists and hospital surgeons was accompanied by a significant increase in early-stage diagnoses, a critical factor in conditions such as inflammatory bowel disease and colorectal cancer. Standardized protocols, broader deployment of modern diagnostic tools and earlier treatment adjustment contributed to lower hospitalization rates and an almost two-fold reduction in surgical interventions. These trends mirror global shifts toward outpatient-focused management supported by contemporary pharmacotherapy, remote monitoring and integrated data systems. Reductions in repeat admissions and inpatient bed-days yield not only clinical but also economic benefits, enabling health systems to reallocate resources toward prevention and infrastructural improvement.

Equally important are the patient-centered outcomes. Rising levels of patient satisfaction, improved communication with clinicians and higher adherence to therapy indicate that the digital platform facilitates a more collaborative care model. Ready access to recommendations, the ability to contact clinicians remotely and improved transparency of the care pathway strengthen the patient's active role in disease management. These observations align with international evidence showing that telemedicine models provide clinical outcomes comparable to traditional in-person care while outperforming them in terms of convenience and perceived service quality.

From an international perspective, this project represents one of the first comprehensive examples of digital restructuring of specialized care in Central Asia. Unlike previously reported narrow applications-such as postoperative telemonitoring or remote consultations for selected conditions-this study demonstrates a system-level integration of all stages of care into a single platform [8]. The adopted model is consistent with European expert recommendations, which

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emphasize the importance of combining in-person initial assessment with digital follow-up, including multidisciplinary teleconferences.

It is important to note that the platform's effectiveness was driven not only by technological solutions but also by managerial measures such as staff training, updates of local protocols and administrative support. This reinforces the principle that digital tools yield substantial results only when embedded into broader process transformation. Limitations of the study include the absence of randomization, the moderate geographic scope and the medium-term duration of follow-up. However, the magnitude and stability of the observed changes support the clinical and organizational relevance of the findings. Future work should include expansion of the platform to other medical specialties and long-term studies to assess sustained clinical impact and economic viability.

Key Findings of the Study

1. An integrated PresentMed routing platform was developed and implemented, providing continuous data exchange across all levels of care, standardized clinical workflows and full transparency of the patient pathway.
2. Diagnostic efficiency improved markedly: the diagnostic interval was reduced by approximately 45%; uncoordinated referrals decreased by 40%; and access to specialist consultations increased due to a two-fold rise in telemedicine interactions. Documentation quality and protocol adherence also improved, reaching 97% compared with the previous 94%.
3. Early detection rates increased from 20% to 40%, and the use of modern diagnostic methods expanded by 1.5–4.5 times. The need for surgical interventions nearly halved (from 25% to ~14%), while the frequency of complicated cases and emergency hospitalizations decreased by more than one-third. Patients with chronic intestinal disorders demonstrated longer remission periods.
4. Patient-reported outcomes improved substantially: mean satisfaction rose from 4.2 to 7.3 points, and PACIC indicators related to patient participation and awareness increased by more than 40 percentage points. Treatment adherence improved from 32% to 69%, highlighting the effectiveness of a patient-centered approach within a digital environment.
5. Direct healthcare expenditures per 1,000 patients decreased by 39% due to reductions in surgeries, hospitalizations and complicated cases. This creates opportunities for reinvesting savings into prevention, workforce development and infrastructure enhancement.
6. The findings support broader adoption of the platform-based model across additional regions and medical specialties. The integration of modern IT solutions with organizational reforms provides a foundation for a sustainable, efficient and patient-oriented system of specialized care.

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