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Application Effect of Intelligent Guidance Optimization in Physical Examination Process Management

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Abstract: *Objective*: To investigate the application effects of intelligent guidance systems in optimizing health check-up process management. *Methods*: A total of 400 examinees who underwent physical examinations at the hospital's Health Management Center from January to December 2024 were randomly divided into a control group (200 cases) and an observation group (200 cases). The control group used traditional manual guidance methods, while the observation group employed the intelligent guidance system. The study compared two groups in terms of completion time, waiting time for each procedure, check-up efficiency scores, examinee satisfaction, and report issuance time. *Results*: The overall examination time in the observation group (85.3 ± 12.7 minutes) was significantly shorter than that in the control group (142.6 ± 18.5 minutes) ($P < 0.01$); average waiting time per procedure decreased by 62.4%; check-up efficiency scores (8.9 ± 0.8 points) were significantly higher than those in the control group (5.2 ± 1.1 points) ($P < 0.01$); satisfaction reached 96.5%, significantly higher than the control group's 78.0% ($P < 0.01$); and report issuance time was advanced by 1.5 days. *Conclusion*: Intelligent guidance systems can significantly optimize check-up processes, improve work efficiency, and examinee satisfaction, demonstrating significant clinical application value.

Keywords: Intelligent guidance; Check-up process; Health management; Process optimization; Satisfaction

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1. Introduction

With the deepening implementation of China's Healthy Nation strategy and growing public health awareness, health checkups have become a vital tool for disease prevention and health management. However, traditional checkup models suffer from cumbersome procedures, lengthy waiting times, and inefficient triage processes, significantly impacting both patient experience and medical resource utilization efficiency. In recent years, the integration of information technology with healthcare has provided innovative solutions for optimizing checkup workflows. The intelligent triage system, leveraging AI algorithms and IoT technologies, achieves precise management and optimized resource allocation through real-time data analysis, smart route planning, and

automated reminders. Research indicates that this system dynamically adjusts examination routes based on real-time patient flow and processing time across departments, effectively avoiding resource idling and congestion caused by rigid protocols. Additionally, the system delivers real-time navigation guidance via mobile devices, reducing unnecessary movement and alleviating patients' anxiety during waits. Currently, empirical studies on intelligent triage systems in checkup optimization remain limited in China, particularly lacking multi-dimensional quantitative evaluations of their effectiveness. This study employs a controlled trial design to systematically assess the practical outcomes of intelligent triage systems in shortening checkup durations, improving operational efficiency, and enhancing patient satisfaction, providing scientific evidence for process optimization and digital transformation in health checkup institutions [1].

2. Data and methods

2.1. General information

A total of 400 participants were selected for this study from those who underwent health check-ups at our hospital's Health Management Center between January and December 2024. Inclusion criteria: aged 18–65 years; choosing the selected health check-up package; voluntarily participating in the study and signing an informed consent form; possessing smartphone operation skills. Exclusion criteria: elderly or disabled individuals requiring special care; emergency check-ups or expedited check-ups; participants who withdrew midway. The subjects were randomly divided into a control group (200 cases) and an observation group (200 cases) using a random number table method. The control group included 102 males and 98 females, aged 22–63 years with an average age of (41.5 ± 10.3) years. The observation group comprised 105 males and 95 females, aged 20-65 years with an average age of (42.1 ± 11.2) years. There was no statistically significant difference between the two groups in baseline data such as gender, age, and health check-up package type ($P > 0.05$), indicating comparable comparability [2].

2.2. Methodology

The control group adopted the traditional manual guidance mode, in which the guidance nurse guided the subjects to complete each examination step by step according to the fixed process, and the subjects queued up outside each examination department by themselves. The observation group applied the intelligent guidance system to manage the physical examination process, and the specific implementation plan was as follows:

2.2.1. Composition of intelligent guidance system

(1) Data Collection Module: Acquire physical examination appointment information through the Hospital Information System (HIS), deploying IoT sensors across departments to collect real-time progress and crowd data.

(2) Intelligent Algorithm Module: Utilize deep learning algorithms to analyze historical examination data, establishing time prediction models for each test item; employs reinforcement learning algorithms to optimize examination routes in real time.

(3) Mobile Application Module: Develop a patient-facing app providing real-time guidance, queue updates, department navigation, and report retrieval.

(4) Management Backend Module: Offers healthcare professionals interfaces for monitoring examination workflows, resource allocation, and handling anomalies [3].

2.2.2. System workflow

(1) Booking stage: The examinee makes an appointment for physical examination through the APP, and the system recommends the optimal time according to historical data.

(2) Preparation for physical examination: The APP pushes the matters needing attention and preparation instructions, and reminds special requirements such as fasting.

2.2.3. On-site guidance

Upon arrival, examinees complete quick registration via facial recognition or QR code scanning. The system generates personalized examination routes based on real-time data, while the APP displays upcoming tests, estimated waiting times, and department locations in real time. Smart reminders prioritize scheduled procedures requiring fasting, such as blood draws and ultrasounds.

(1) Process monitoring: The management backend continuously monitors departmental workload, dynamically adjusts guidance strategies, and intervenes proactively with patients experiencing delays.

(2) Report generation: The system automatically consolidates test results, assists doctors in report review, and delivers electronic reports through the APP [4].

2.3. Observation indicators

(1) Time efficiency index

(a) Overall test time: The time from registration to completion of all tests.

(b) Waiting time for each link: the waiting time for major tests such as blood collection, ultrasound, and radiation.

(c) Report time: the interval between completion of tests and availability of reports.

(2) Quality evaluation indicators

(a) Physical examination efficiency score: Researchers used a Likert 5-point scale to evaluate the rationality of the process (1–10 points).

(b) Guidance accuracy: The consistency between the route recommended by the system and the actual completed route.

(c) Incidence of abnormal events: The number of adverse events, such as missed detection and wrong detection

(3) Satisfaction index

(a) Respondent satisfaction survey: Self-made questionnaire was used to evaluate the guidance service, waiting time, and overall experience.

(b) Medical staff work satisfaction: Evaluation of system use experience and workload changes.

2.4. Statistical methods

SPSS 26.0 was used for data analysis. The mean ± standard deviation (x±s) was used for measurement data, and the independent sample t-test was used for intergroup comparison; the number of cases (percentage) was used for counting data, and the χ^2 test was used for intergroup comparison. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Comparison of two groups of time efficiency indicators

The observation group's overall examination time was significantly shorter than the control group (85.3 ± 12.7 minutes vs 142.6 ± 18.5 minutes, t=35.672, $P < 0.01$). Across all examination stages, blood collection waiting time decreased from (25.3 ± 6.8) minutes to (8.2 ± 3.1) minutes, while ultrasound waiting time reduced from (38.5 ± 9.2) minutes to (14.7 ± 5.3) minutes—all showing statistically significant differences ($P < 0.01$). The time required for issuing physical examination reports was shortened from 2.5 days in traditional methods to 1.0 day, as shown in **Table 1**.

Table 1. Comparison of time efficiency indexes between the two groups (x±s)

Metric	Control group (n = 200)	Observation group (n = 200)	*t* price	*P* price
Total inspection time (min)	142.6 ± 18.5	85.3 ± 12.7	35.672	< 0.001
Waiting time for blood collection (min)	25.3 ± 6.8	8.2 ± 3.1	32.145	< 0.001
Ultrasound waiting time (min)	38.5 ± 9.2	14.7 ± 5.3	30.876	< 0.001
Waiting time for radiography (min)	22.7 ± 7.5	9.5 ± 4.2	21.543	< 0.001
Date of report (days)	2.5 ± 0.8	1.0 ± 0.3	25.432	< 0.001

3.2. Comparison of two groups of quality evaluation indicators

The observation group demonstrated significantly higher physical examination efficiency scores compared to the control group (8.9 ± 0.8 vs 5.2 ± 1.1 points, t=38.765, $P < 0.01$). The diagnostic accuracy rate reached 97.3%, markedly exceeding the control group's 82.5% (χ^2=25.432, $P < 0.01$). The observation group recorded 1 missed detection and 0 false detection cases, with a non-adverse event incidence of 0.5%; in contrast, the control group experienced 8 missed detections, 3 false detections, and a non-adverse event rate of 5.5%, showing statistically significant differences (χ^2=9.876, $P < 0.01$), as shown in **Table 2**.

Table 2. Comparison of two groups of quality evaluation indicators

Metric	Control group (n = 200)	Observation group (n = 200)	Statistic	*P* price
Physical examination efficiency score (score)	5.2 ± 1.1	8.9 ± 0.8	t=38.765	< 0.001
Guidance detection accuracy (%)	82.5	97.3	χ^2=25.432	< 0.001
Number of missed cases (e.g.)	8	1		
Number of cases misread (e.g.)	3	0		
Adverse event incidence (%)	5.5	0.5	χ^2=9.876	0.002

3.3. Comparison of satisfaction between the two groups

The observation group achieved an overall satisfaction rate of 96.5% (193/200), significantly higher than the control group's 78.0% (156/200) (χ^2=32.765, $P < 0.01$). In dimensions such as medical guidance services, waiting time, and overall experience, the observation group demonstrated statistically significant superiority over the control group ($P < 0.01$). Healthcare staff job satisfaction increased from 68.0% to 89.5% (χ^2=15.432, $P < 0.01$), as shown in **Table 3**.

Table 3. Comparison of satisfaction between the two groups [n(%)]

Evaluative dimension	Control group (n = 200)	Observation group (n = 200)	χ^2 price	*P* price
Very satisfied	62(31.0)	135(67.5)	52.342	< 0.001
satisfied	94(47.0)	58(29.0)	13.765	< 0.001
same as	32(16.0)	6(3.0)	19.876	< 0.001
discontent	12(6.0)	1(0.5)	9.543	0.002
Overall satisfaction	156(78.0)	193(96.5)	32.765	< 0.001

4. Discussion

4.1. The intelligent guidance system significantly improves the efficiency of physical examination process

The research findings demonstrate that the intelligent triage system reduces overall examination time by 40.2% and decreases waiting time for major procedures by over 60%, primarily through real-time data analysis and dynamic path optimization. Traditional physical examinations, relying on fixed workflows and manual scheduling, struggle with unpredictable workload fluctuations across departments, often leading to uneven resource distribution and queue bottlenecks. The system employs IoT technology to monitor queuing conditions in real-time, combining historical data with predictive models to accurately assess current status and forecast future trends. Through reinforcement learning algorithms, it continuously optimizes triage strategies, dynamically adjusting patient flow management based on real-time data to achieve balanced resource utilization. Notably, the system prioritizes time-consuming procedures like ultrasound examinations requiring fasting, effectively preventing discomfort and process interruptions caused by prolonged waits in traditional methods. The significant reduction in report generation time highlights the system's advantages in result aggregation and automated report generation, providing valuable time for subsequent health management [5].

4.2. Intelligent guidance improves the quality and safety of physical examination

The intelligent guidance system not only enhances physical examination efficiency but also significantly improves quality through standardized procedures and smart reminders. Research data shows the observation group achieved 97.3% guidance accuracy with a mere 0.5% adverse event rate – notably superior to traditional methods. The system's standardized workflow template ensures every participant completes all required tests through optimal pathways, eliminating potential omissions or sequencing errors in manual guidance. The mobile app's real-time navigation reduces participant confusion and unnecessary movements in unfamiliar environments, lowering misdiagnosis risks. An anomaly retention alert mechanism promptly identifies problematic procedures, enabling staff to intervene proactively and prevent interruptions or result in omissions caused by individual factors. Additionally, the system's automated report generation streamlines information management, reducing human errors and providing digital safeguards for quality control. These combined improvements ensure safer, more reliable examinations with accurate and comprehensive results.

4.3. Intelligent guidance and optimization of examinee experience and medical work mode

The participant satisfaction survey demonstrates that the intelligent guidance system significantly enhances physical examination experiences. With 96.5% satisfaction, participants highly appreciate its shortened waiting

times, clear navigation instructions, and user-friendly procedures. In traditional checkups, unpredictable wait durations and complex routes often caused anxiety and dissatisfaction. The real-time queue information and estimated wait times provided by the smart guidance app allow patients to clearly anticipate their progress, effectively reducing waiting stress. The indoor navigation feature helps locate examination departments quickly, minimizing confusion and fatigue during searches. From healthcare professionals' perspective, the system frees guides from repetitive directions, enabling them to focus on handling emergencies and providing personalized services for special needs. The management backend's real-time monitoring and data analysis help administrators scientifically assess departmental workloads and optimize staffing. This operational transformation not only improves service efficiency but also enhances healthcare workers' job satisfaction, with 89.5% of respondents endorsing the system's practicality in daily operations. These advantages make the intelligent guidance system an effective tool for elevating health checkup service quality and patient experience.

5. Conclusion

The intelligent guidance system significantly optimizes health check-up process management, reducing examination time and waiting periods while enhancing work efficiency, improving quality of care, and boosting patient satisfaction along with healthcare professionals' job experience. By deeply integrating information technology with health management, this system achieves intelligent, personalized, and efficient check-up procedures, demonstrating significant clinical application value and promising prospects for widespread adoption. Health check-up institutions are advised to adapt the system according to their specific needs, continuously refine its functions, and provide patients with superior medical services through smart guidance technology.

Disclosure statement

The author declares no conflict of interest.

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