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# SMART REHABILITATION CLINIC

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## ABSTRACT

**Objective:** With the advancement of information technology, the concept of smart rehabilitation clinics has gradually become a reality. As the concept of smart rehabilitation clinics has not been previously introduced in the literature, we list the essential factors that promote smart clinic transformation and the current state of smart clinics in various critical fields in this review.

**Discussion:** Smart clinics employ a new generation of information technologies, such as technological enablement, digitalization, automation, artificial intelligence, telemedicine, virtual reality, and robotic rehabilitation equipment, to completely revolutionize the existing medical system, making it more efficient, easy, and personalized.

**Conclusion:** This paper reviews the characteristics of smart clinics and evaluate the prospects for smart clinic owners. (*J Contemporary Chiropr* 2022;5:7-12)

**Key Indexing Terms:** Smart Clinic; Rehabilitation Clinic; Artificial Intelligence

## INTRODUCTION

The healthcare industry has evolved tremendously over the years, and many of these changes have been promoted by technological enablement, digitalization, and automation. Artificial intelligence (AI), telemedicine, virtual reality, robotics, precision medicine, 3-D printing, genomics, and other emerging technologies can now be integrated into healthcare clinics in various ways. (1)

Rehabilitation typically involves balancing science, philosophy, and the art of medicine. Art is often considered to be a manual technique and empathy expressed by a caregiver to a patient. Science is limited to the data analysis of each therapy. It is now an innovation age driving the extraordinary breakthroughs in patient care, helping the patient journey, and making preventative decisions. The use of these technologies is heavily dependent on the clinician's mindset, including considerations of cost control, efficiency optimization, and patient outcomes. Rehabilitation clinicians are primarily trained to use their hands; therefore, consumer expectations may often be ignored regarding the application of new treatment

technologies. Fifty-nine percent of consumers in the United States would appreciate a digital healthcare experience. (2) Furthermore, patients expect healthcare services to be provided more quickly, be more accessible, comfortable, and personalized.

## DISCUSSION

### *Essential Factors of Smart Rehabilitation Clinic Transformation*

Typically, clinics are smart when they are future-ready. Smart rehabilitation clinics incorporate innovative technologies into their design and operations to improve the patient journey, treatment outcomes, and operational costs. These technologies are used to improve care delivery within the center and incorporate it into a larger healthcare delivery ecosystem involving the hospital system. Most rehabilitation clinics are in the nascent stages and have only begun with some essential technologies, such as automatic booking systems. They are challenged regarding integrating new technologies into patient care delivery. This study defines the critical factors that promote smart clinic transformation and discusses implications for investors and operators.

- Demand for Clinical Outcomes and Quality

Diagnostic and treatment errors are prevalent in the healthcare industry. In the United States, over US \$210 billion is charged for "unnecessary services." (3) Saber et al (4) revealed that 47% of diagnostic error-related adverse events result in severe disability, and over 20% of orthopedic surgeons would perform a wrong-site surgery at some time during their careers. (5) To fundamentally change, the healthcare system must be completely transformed. Artificial intelligence, robotics, and other emerging technologies have the potential to improve diagnostic and treatment precision and reduce the risk of error.

- Corporatization of Rehabilitation Clinics

Due to market demands in different countries, the leading rehabilitation groups offer a variety of wellness services in addition to physical therapy. In the United States, IMAC, a Nasdaq-listed chiropractic group, has been delivering a variety of routine testing and treatments, including stem cell therapy, through rehabilitation clinics. (6) Singapore's largest physiotherapy group, Core Concepts,

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## Smart Rehab Clinic Transformation

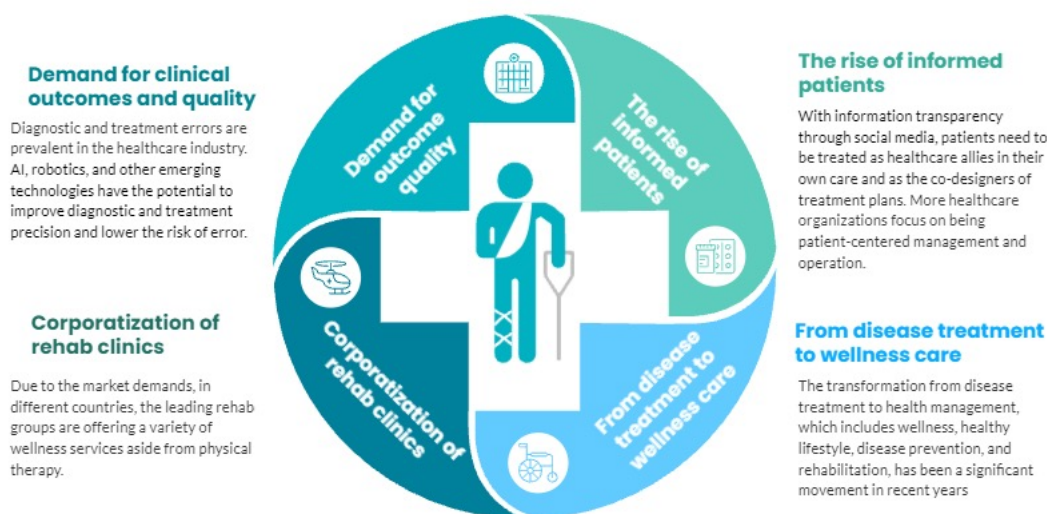


Figure 1. The Smart Clinic Transformation

also offers a variety of self-branded wellness and Pilates services to rehabilitation patients and 43% of the practitioners are not licensed physiotherapists. (7) TAGS Spine and Joint Specialists, a Malaysian rehabilitation clinic with 42 physiotherapists and 14 chiropractors, uses new technologies as part of the transition to outpatient care by enabling considerable integration across various disciplines, including traditional Chinese medicine, radiology, physiotherapy, orthopedics, and orthotics, which enhances treatment quality and patient satisfaction. (8) Australia's 2.2 billion dollar physiotherapy industry offers pain-free physiotherapy and allied health provided podiatry, dietetic, acupuncture, and massage wellness care. (9)

- The Advent of Informed Patients

With information transparency through social media, patients need to be treated as allies in their own healthcare and included as co-designers of treatment plans. More healthcare organizations now focus on patient-centered management and operations. Rather than passively following doctors' advice and accepting treatment, evidence suggests a positive correlation between positive patient journey and symptom recovery with patient engagement, adherence to healthcare advice, clinical outcomes, and decreased redundancy in service utilization. It has been reported that patients' experience is directly related to clinical longevity. (10)

- From Disease Treatment to Wellness Care

The transformation from disease treatment to health management, which includes wellness, healthy lifestyle, disease prevention, and rehabilitation, has been

significant in recent years (Figure 1). Patients who want to live longer, healthier lives, and those facing economic constraints are driving the demands. Many countries around the world are transitioning to health management. For instance, the Singapore government created the Health Promotion Board to encourage Singaporeans to embrace healthy lifestyles by disseminating evidence-based information and illness prevention initiatives to their homes, businesses, and schools. (11) Residents of Singapore are encouraged to pay attention to their diet, exercise regularly, and undertake preventive screenings, all of which serve to lower the risk of disease development (or progression) and hospitalization. The Health Promotion Board also provides residents with a tangible thrust to stay out of, and get out of hospitals by focusing on the non-hospital elements of the overall patient care pathway.

### Characteristics of Smart Clinics

Images of smart chiropractic clinics where real-time patient information arrives on-site before the patient, check-in desks are not required, and treatment and preventive recommendations are based on an entirely new spectrum of technological enablement, digitalization, automation, AI, telemedicine, virtual reality, and robotic spinal adjustment are intriguing. Here, we describe the characteristics of smart chiropractic clinics.

- Smart Clinics Provide Services at Multiple Sites

These clinics focus on a smaller number of high-value services delivered through a larger network of organizations, many of which are not usually linked with healthcare. For example, preventive treatments and

healthcare management programs are provided in clinics, gyms, and even using patient home devices. Ambulatory care centers offer a variety of medical treatments and procedures. Therefore, only major surgeries, intensive care, management of severe trauma, and treatment for other acute and complicated disorders are delegated to hospitals.

TVG-Medulla, a USA-based preventative chiropractic corporation, provides administrative support services to 102 clinics, including 82 wellness clinics and 14 hospital-based MyoCore clinics. Their service encompasses the entire spectrum of rehabilitation services at multiple sites with various specialties. Patients with severe conditions can also access their 14 hospital clinics for full recovery.

- Smart Clinics are Part of the Digital Ecosystem

As primary care providers, rehabilitation clinics possess full personal health records that can be synchronized with hospital electronic health record (EHR) systems. Health data can be combined with claims data, health behaviors, and DNA data, to thereby guide the development of preventive and precision treatment, drug discovery, and health policy recommendations. (12) In addition, at EC Healthcare, a Hong Kong rehabilitation clinic, patients wear PlainSight—a mobile EKG analysis solution that collects and tracks a detailed measurement and risk analysis. The clinical staff use mobile devices to access all health data, which enables more efficient clinical operations.

- Smart clinics are automated

Smart clinics rely on various technologies to enhance operations and automate procedures, resulting in a considerable increase in total productivity and accuracy. For example, the use of radiofrequency identification (RFID), bar codes, and other novel sensing technologies can improve internal management. In various care settings, automated procedures and gadgets replace certain human operations, enabling employees to devote more time to direct patient care. Many back- and front-office activities are automated to increase efficiency. The efficiency of clinical operations is further improved through web-based tracking of all patient services, computerized capacity allocation, and digital patient record administration.

Leading spine rehabilitation clinics in China have already demonstrated the benefits of automation. For instance, Aspine in Shanghai uses digital technologies to automate almost 80% of its back-of-the-house services, thereby enabling clinical staff to spend more time with patients, and implement other clinical care improvements. As a result, enormous productivity gains and higher-quality care delivery are provided. Additionally, clinicians can work and complete a master's degree using the system.

(13)

- Smart Clinics are Patient-Centric and Offer a Superior Patient Journey

To promote patient-centricity and improve patient satisfaction, smart technology has facilitated enhancement of the patient experience. A patient can employ wearables or remote-sensing equipment to monitor and record blood pressure in real time before initiating treatment. When the device detects an unusual reading, an automated warning is transmitted to the patient. The patient can then upload the blood pressure data and communicate with online staff to assist in identifying a suitable physician and to confirm an appointment.

The patient's identity can be verified with an identification card, fingerprint, or facial recognition upon arrival at the clinic. The patient is greeted by the IT system, which performs an automatic triage and records the type of insurance. The system then instructs the patient on which room to go to next, the exams that will be conducted, and the directions to be followed. The technology instantly sends the digital results to the patient's mobile phone on completion of the exams. Platinum System helps chiropractic practices streamline operations related to insurance billing, business performance tracking, payment processing and more on a centralized platform. It also enables front-desk employees to create insurance aging reports, add multiple cases on a single file, generate color-coded ledgers and collect payments via credit cards. It lets medical practices handle patient routing, track missed appointments, send email or SMS blasts and generate personalized patient documents. (14)

To improve the patient experience at the smart rehabilitation center, the physiotherapist implemented an IT system on a smartphone. The system automatically detected the patient's check-in, displayed personalized information (such as waiting time) on a wall-mounted panel at the reception and treatment rooms and transmitted progress reports to both doctors and patients. Clinicians can also customize the system with outcome assessments, notifications, patient satisfaction questionnaires, and process patient payments. (15)

- Smart Clinics are Driven by Data Analysis

Even a high-volume chiropractic clinic may not always have sufficient data to fully realize the promise of analytics on its own and would benefit from having access to clinical data obtained by other entities in the health ecosystem. Data collection operations should consider both what is legally appropriate and what is required to ensure patient privacy under all circumstances. Advanced analytics can significantly improve treatment quality and operational efficiency when clinics have easy access

to data via digital connections. For example, analytics can assist in speeding up diagnosis, enabling early risk detection and response, and optimizing the use of essential facilities. Examples of such applications include the following:

A. Artificial intelligence uses image analysis to identify a variety of diagnoses, and research has revealed that AI can now match the diagnostic accuracy of human physicians. (16) Collaborations between medical practitioners and AI scientists are assisting to combat many diseases. For example, the New York Chiropractic and Physiotherapy Centre, a Hong Kong rehabilitation clinic chain, utilizes an AI-derived system developed by the Chinese University of Hong Kong to differentiate early Alzheimer’s disease from other common neurodegenerative cognitive disorders. AI-derived technology can achieve high accuracy in detecting Alzheimer’s disease, dementia with Lewy bodies, frontotemporal dementia, and early stage neurodegenerative cognitive disorders in clinical settings. (17) Clinicians can also provide conservative treatments under these conditions with scientific re-evaluation. Another team of specialists in China worked in 7 hospitals over 2 months to develop machine-learning software. By training the software on more than 145 000 chest X-ray images, they developed an algorithm to detect respiratory diseases with over 90% accuracy. (18) Their rehabilitation clinics can provide immediate treatments for quick patients’ recovery journeys.

B. Patient records were analyzed using big-data analytics to assist patients who required early intervention and care provision. The system enables clinicians to increase the efficiency of searching for clinical information and provides more time for treating patients. Preventative programs and economically viable rehabilitation treatments can then be established for specific patient groups. Online monitoring and delivery of rehabilitation strategies support improvements in physical activities and thus promote physical functioning in persons with chronic conditions. (19) Additionally, big-data analytics can be used to combine a variety of factors from clinical records (e.g. the amount of time required to complete various procedures and the amount of time required for patient dressing) to optimize treatment room scheduling. Consequently, the idle time between procedures can be minimized.

For example, during patient consultations at the rehabilitation community clinic, clinicians at the United Family Healthcare in China use data analysis to obtain current, evidence-based clinical information to support clinicians’ decision-making processes. The analysis facilitates clinical decisions and determines the optimal treatment plan and rehabilitation program. The system also provides education specific to patients on topics of interest concerning their condition and reviews patients. (20)

• Smart Clinics With Robotic Technology

By supporting clinicians in providing continuous training for extended periods and collecting data to

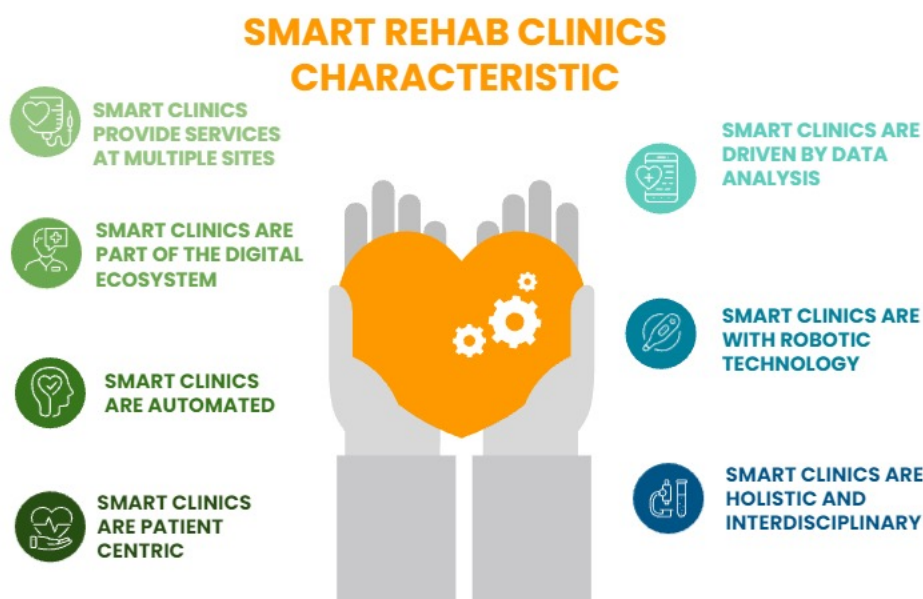


Figure 2. The Smart Clinic Transformation

monitor progress, robotic technology meant to assist rehabilitation can potentially boost the efficiency and accessibility of therapy. Through telerehabilitation, automation of care could enable numerous patients to be treated simultaneously and perhaps even remotely in the comfort of their own homes. The information gathered can be used to objectively evaluate performance, track compliance, and progress. These factors can help clinicians efficiently handle a considerably greater number of patients. Most crucially for patients, it can expand access to therapy, which is frequently in great demand and heavily rationed in today's economic situation. In recent years, many low-cost home devices have been embraced for use in therapy sessions, and strategies for improving motivation and engagement have been incorporated. (21)

In the United States, some chiropractic rehabilitation clinics have integrated a popular robotic technology called spinal decompression units to treat low back pain. According to an online poll released in a chiropractic trade journal, 38% of chiropractors use technology in their offices. Traction in the chiropractor's office rose from 73.2% in 1991 to 80.6% in 2003, representing as many as 5 000 new traction units among chiropractors. (22) In Hong Kong, the New York Chiropractic and Physiotherapy Center has also unitized robotic spinal treatments for cervical pathology and lumbar disc herniation. Precision robotic treatments are commonly utilized in synergy with home devices. (23, 24)

- Smart Clinics are Holistic and Interdisciplinary Owners

While smart clinics require advanced information technology, becoming a smart clinic is not an information technology project. Rather, it is a holistic, deeply ingrained, system-wide approach that involves all staff members, including clinicians, nurses, clinic managers, and investors. (Figure 2) Continuous, transparent communication is also necessary to ensure that possible problems are identified quickly, and viable solutions are immediately found, designed, piloted, and implemented. In this manner, clinical processes, quality of treatment, and patient experience continue to improve, while expenses remain manageable.

#### *What Should Every Smart Clinic Owner Do?*

- Create a Smart Vision

Creation of a smart tool to differentiate the clinic owner and foster long-term innovation Rather than blind investments focusing on hardware upgrades, a sustainable smart clinic should have a broad vision, a clear roadmap for specific use cases (e.g., becoming the country's premier rehab center), and refreshed systems in place to make the vision work.

- Identify the Diagnostic and Treatment that Other Entities Cannot Perform

Rather than attempting to provide all services that every rehabilitation clinic provides, the clinic owner should identify the diagnostic and treatment services that other entities cannot perform, and then determine how to provide those services efficiently and to a high standard.

- Improve the Culture for Innovation

Although smart clinics require novel technologies, it is critical for clinic clinicians and operators to innovate regularly to improve patient outcomes. A clinic can only invest so far with sophisticated hardware and software systems. Clinicians should explore new techniques that increase patient-care quality and establish open cooperation with universities, research institutes, and innovative technology projects. The clinic operators shall consider healthcare delivery in larger dimensions and form close partnerships with government agencies to YouTubers and critical opinion leader collaborations.

## CONCLUSION

Smart rehabilitation clinics in the future will resemble neither today's nor yesterday's clinics. Smart clinics will drive a better vision, owning a clear roadmap, using innovative diagnoses and treatments, and interacting with a larger ecosystem to efficiently supply other care services. There are challenges when the innovators try to build the smart clinic. The compliance of data collection and cost of IT system may not provide enough return of investment for average clinic owners. In addition, many patients are not in desire of the technology due to cultures, backgrounds, education and generations. However, when the time of technological age has arrived, the clinical staff who are digitally equipped will be able to provide better outcomes and a more integrated patient journey in smart clinics and continue to innovate in care delivery.

Funding Sources and Conflicts of Interest: No funding sources or conflicts of interest were reported for this study.

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