

# Telehealth Ecosystem: Challenge and Opportunity

R. Poonsuph

**Abstract**—Technological innovation plays a crucial role in virtual healthcare services. A growing number of telehealth platforms are concentrating on using digital tools to improve the quality and availability of care. As a result, telehealth represents an opportunity to redesign the way health services are delivered. The research objective is to discover a new business model for digital health services and related industries to participate with telehealth solutions. The business opportunity is valuable for healthcare investors as a startup company to further investigations or implement the telehealth platform. The paper presents a digital healthcare business model and business opportunities to related industries. These include digital healthcare services extending from a traditional business model and use cases of business opportunities to related industries. Although there are enormous business opportunities, telehealth is still challenging due to the patient adaption and digital transformation process within a healthcare organization.

**Keywords**—Telehealth, Internet hospital, HealthTech, InsurTech

## I. INTRODUCTION

TELEHEALTH represents an opportunity to redesign the way health services are delivered. The new approach to health service delivery has been developed globally. With digital health services, the patient joins into a telehealth platform, makes an appointment with a preferred physician, consults for diagnostics via teleconsultation, and obtains a prescription for drug delivery at home. On the other hand, patients may choose to go to a medical consultation facility near their home and meet through teleconsultation with a physician based in a top-level hospital. Telehealth has already proven effective to help patients with common care, chronic care, and emergency consultation for rural patients. In addition, telehealth provides medical services, including regular follow-up, medication instructions and contactless medicine delivery. According to a study by McKinsey, the rise of telehealth usage is up to 46% from 2019. In addition, the providers have reported that range of 50 and 175 times the number of patients using telehealth [1].

With the accelerated growth of telehealth, which is called internet hospitals in China, as of July 2020, there are approximately 711 internet hospitals in China, according to research published in the Journal of Medical Internet Research [2]. WeDoctor, China's largest telemedicine network, owns at least 27 internet hospitals and has linked its appointment-making system to 7,800 hospitals across China. The network hosts over 270,000 doctors and has 222 million registered patients. The advantages allow WeDoctor to give users an "integrated online and offline" health care experience [3].

Telehealth system helps patients to lower their healthcare

costs compared with traditional service models. Compared with physical hospitals, telehealth has higher efficiency at lower cost, optimized resource distribution and independent treatment. Telehealth consultations reduce rates of lab, imaging, and antibiotic use, overutilization that drives costs in health care. The present cost of drugs of a prescription from telehealth is cheaper on average from a top-level hospital. As telehealth also reduces emergency room utilization and readmission rate, it helps care providers save costs. According to statistics, Jefferson Health saves from \$309 to more than \$1,500 on each avoided emergency department visit. Cost savings from other alternate care types was below \$114 average savings per visit [4]. Moreover, telehealth enables care providers to outsource remote analysis services and avoid the cost of specific medical equipment and highly specialized medical staff.

Fig. 1 shows that the prediction model using telehealth at an early stage of treating the illness will reduce the cost as the expectation line [5]. A patient with more severity of illness symptoms typically has a higher cost of healthcare treatments in traditional service models. With telehealth service, the treatment starts earlier, the severity is reduced, and the cost is minimized.



Fig. 1 Prediction model using telehealth at an early stage of treating the illness will reduce the cost compared with traditional healthcare

With the low-cost services, telehealth builds a new ecosystem that creates a different business opportunity for healthcare and related industries. For the healthcare industry, the challenges and opportunities for businesses in digital services are enormous. Telemedicine is for common diseases and chronic care. Teleconsultation is for advanced care between healthcare professionals. Teleconsultation is also used for behavior therapy and psychologists with children and clinical social workers. Telerehabilitation is for coaching support and training for rehabilitation procedures. For the health insurance

R. Poonsuph is with the National Institute of Development Administration (NIDA), Bangkok, Thailand. (e-mail: rattakorn@as.nida.ac.th).

carriers business, telehealth can offer a low-cost subscription program for general patients with limited financial incomes. Additionally, a different insurance product with a digital health service policy for various target customer segmentation is emerging.

The telehealth ecosystem is still evolving. The innovative business model of digital health service is open for third-party participants to join the telehealth solution platform for enhancing the patient experience.

## II. RESEARCH OBJECTIVES

Digital health services and health technology are now well placed to drive the implementation of healthcare industry reforms designed to improve medical service quality and efficiency, advance remote diagnosis and treatment systems and the overall health management system. As a result, the global digital healthcare companies are widely spread over the world. Forty-one healthcare unicorns are valued at \$102 billion in total. Twenty-one companies are located in the United States of America, which are valued at \$56 billion. Eight healthcare unicorns are established in the United Kingdom and Europe, valued at \$14 billion. Surprisingly, nine healthcare unicorn companies are placed in China alone, valued at \$20 billion [6].

The research explores a new business model for virtual health services, including a partnership for the telehealth platform. The market opportunity is worthwhile for healthcare enterprises leading in this direction. The paper presents a digital business model for the healthcare industry and related businesses. The scope covers both extended from existing business in healthcare institutions and digital opportunities. Telehealth offers a variety of digital healthcare services to patients, which never happened before. Thus, the opportunity is broad and diversified for the healthcare industry, insurance business, logistics platforms, financial business, marketing and advertising to offer digital services to their patients or consumers in responding to the unmet demands. Although there are tremendous business opportunities for digital health services and related services, telehealth is still challenging due to patient adaptation to technology and the digital transformation process within a healthcare organization responding to new business demands.

## III. TELEHEALTH ECOSYSTEM

The telehealth ecosystem is broadly associated with several industries the government organizations. Fig. 2 illustrates all participants in the telehealth ecosystem. So, the government provides primary healthcare for their citizens while insurance healthcare carriers offer additional healthcare services to particular consumers. Employers and labor unions also offer healthcare benefits to their employees and extra compensation for injuries or workplace diseases.

However, the traditional health plan only offers services by

visiting healthcare institutions or hospitals. Meanwhile, virtual care is now widely available to most patients. Healthcare providers are increasingly offering virtual services not only to provide convenience but to enable healthcare providers to manage care for specific patients, such as complex chronic care patients, rural patients, or those with mobility issues.

Ultimately, digital healthcare services via a telehealth platform are the solution for patients with particular symptoms and health conditions. Patients can stay comfortably at home while receiving a healthcare service with telemedicine and medical delivery [7]. To provide digital health services to their citizens, the government must amend the national health policy to cover the digital healthcare services and grant claim reimbursement after using the telehealth platform. At the same time, healthcare providers and participants join the telehealth platform to offer care virtually to their patients.

Relevant business participant associated with the healthcare industry is the insurance business, which provides voluntary healthcare coverage products to their clients. Traditional insurance products are similar to the original national health plan requiring patients to access the healthcare facility to gain coverage, although some healthcare services can offer virtually via telemedicine [7]. Recently, insurers include telemedicine services into their existing products or introduce innovative products to serve different target customers. Moreover, the opportunities from the telehealth platform drive insurers to offer telemedicine and other telehealth services as a new product category with the lower premium to an additional target market segmentation [8].

The telehealth platform offers integrated services among healthcare participants that never happened before. The fragmentation and unconnectedness of existing healthcare services can be integrated into a single application within the digital healthcare services platform [9]. Healthcare service providers are scattered in domestic areas, starting from a primary care provider, referring to specialized care, receiving medication, and making a service payment. The patient journey is desperate with enter-exit of scattering care service facilities due to the referral process to another department, facility, or hospital. With telehealth, the combination of previous healthcare services is merged into one service within the telehealth application. The patient can use the telehealth application at home or visit the local care institution to perform necessary health checkups and virtual consults with all related physicians and healthcare professionals. However, the telehealth platform cannot resolve all of the patient's healthcare concerns. The appointment for subsequent visits at the hospital is essential to further examination, physical diagnostics and treatments. On the other side, telehealth solutions transform patient data from abstract to actionable, so participants can maximize reimbursement, comply with regulations, improve operational efficiencies, enhance care coordination, and enable interoperability.

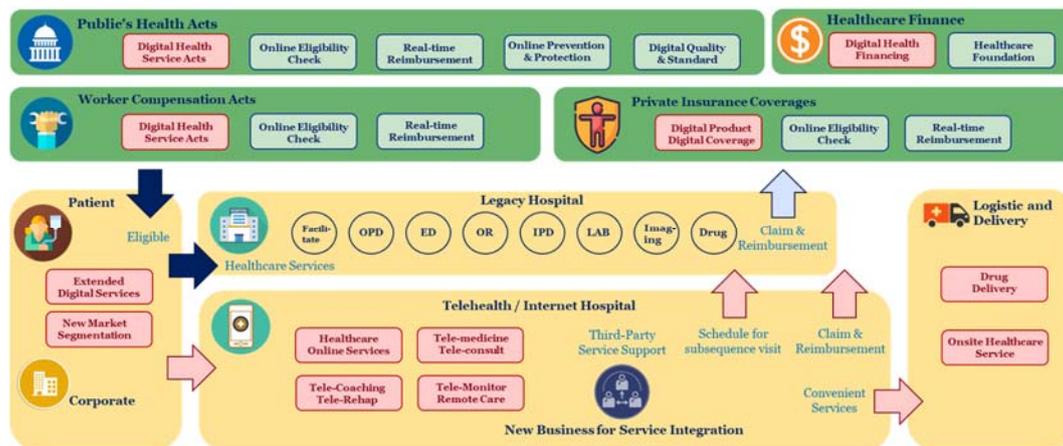


Fig. 2 Participants in Telehealth Ecosystem

Open Science Index, Health and Medical Engineering Vol:16, No:2, 2022 publications.waset.org/10012406.pdf

Inevitably, a healthcare provider, a hospital, and a pharmacy store must coordinate with logistics businesses to deliver drugs or medical supplies to the patients at home. Telehealth logistics participates in the telehealth ecosystem by arranging medical deliveries directly to the patient at home. With telehealth exponential growth, logistics is an essential factor in ensuring delivery arrangement runs smoothly and can be scalable to serve high demands. The challenge of telehealth logistics is to deliver the medical on time based on patient condition and finding a local pharmacy that matches all prescriptions. For an emergency patient in a rural area, a drone may be applicable in medical supply delivery. Furthermore, the coordination between the healthcare providers and logistics business will go beyond medical delivery. For example, portable medical equipment could be shared among patients with illnesses during some periods. Hence, the logistic partners handle the sharing of the medical equipment by performing borrowing and returning operations.

Healthcare financing is another participant in the healthcare ecosystem that supports healthcare for patients who need financial aids. Initially, healthcare financing forms as the foundation that receives the funds from the donations to help out a particular group of patients (e.g., blindness, handicap, and orphaned). However, the advances in healthcare research and health technology extend healthcare services in multiple paces. The particular healthcare treatments include health prevention programs and prolonging wellness treatments, organism replacement operations, and advanced cosmetics surgery, which are very high costs for the patients and cannot be reimbursed from healthcare insurance carriers. So then, healthcare financing is engaged as an affordable program to patients by offering the healthcare loan directly to the patient via the telehealth platform [10].

The telehealth business is a digital twin of the legacy hospital since telemedicine was first launched as a digital front-end service and offers ultimate convenience for the patient who can virtually visit the hospital and perform remote diagnostic with a physician. However, telemedicine is just an early stage of a limited set of virtual care. Many healthcare services can be offered virtually to the patient, which reduces the operation

work-loads from healthcare professionals. Rudimentary telehealth services include viewing and managing an appointment, automatic symptom checker, allergy warning, vital-sign records, electronic health records (EHR), laboratory results, imaging diagnostics results, medical intakes information, and event alerts for patients by using an online application. Besides telemedicine, teleconsulting, telerehabilitation, telepharmacy, and telemonitoring are also included in the telehealth platform. These additional services providers are based upon individual patients as needed.

Onsite care service is another service that provides healthcare professionals to assist the patients at their accommodation. With the onsite care service, the telehealth platform offers matching services between patients and caregivers based on the patient health records and health conditions. As a result, the caregivers can assist the patients onsite with daily routine activities, including accompanying the patient to the hospital, monitoring patient symptoms and health conditions, medication intake assistance, cleaning and bedding services. Furthermore, the telehealth platform received patient feedback for their satisfaction and comments to improve matching algorithm service in the future.

Telehealth solutions extend their digital healthcare services by collaborating with third-party participants, which generates a valuable digital business model to serve patients and related industries. Fig. 3 shows four stages of future telehealth solutions that fully expand to complete digital health services. The early stages are currently serving the patient with the existing platform in both the US and China (e.g., Amwell [11], Teladoc [12], Ro.co [13], WeDoctor [14], Haodf.com [15]). Future telehealth solutions in later stages offer a patient-centric healthcare system that vertically integrates the primary care platform powers a personalized, end-to-end healthcare experience from diagnosis to medication delivery to ongoing care.

Ultimately, telehealth could create enormous value chain business opportunities that can integrate with the telehealth platform. The small unit of medical care can be spread out globally. For example, the health-spot station is digital kiosks enclosed with a small container, free-standing units that use

video consults and real-time interaction with telehealth devices for remote diagnosis [16], [17].

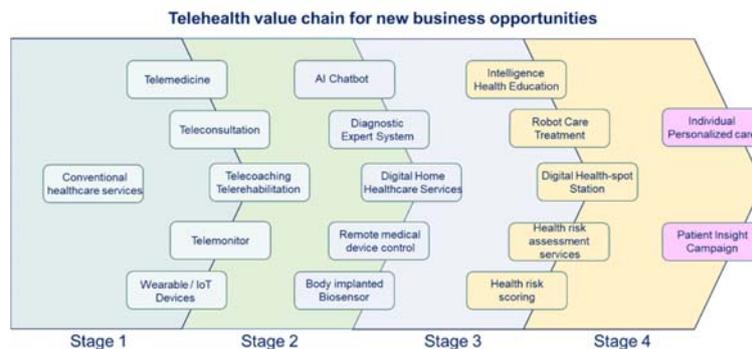


Fig. 3 The potential business opportunity from the future telehealth platform

Open Science Index, Health and Medical Engineering Vol:16, No:2, 2022 publications.waset.org/10012406.pdf

A robot in healthcare offers to assist surgeries, disinfecting rooms, dispensing medication, and other tasks that medical robots will soon undertake in hospitals. Robot care treatment is another possible service that can reside in the health-spot station to obtain blood samples or specimen fluid to indicate the laboratory results.

Digital home healthcare and remote medical device control is the final stage of telehealth solution. A portable medical device and controller module can be attached to a bedridden patient. Healthcare professionals can monitor a patient's vital sign information remotely from the healthcare institution.

Another new business opportunity is the virtual care assistant for elderly patients. United Nations has reported that the population aged 80 and over is projected to grow to 202 million in 2030 [18]. The virtual care assistant for older adults has more demand for healthcare assistance, including digital assistant via teleconference, onsite care services, transportation care services, and virtual rehabilitation services. All of these care assistances are integrated into a single platform of telehealth. There is also an opportunity for international healthcare workers to join the telehealth platform if they pass the qualification. Telehealth allows independent healthcare workers for the health of migrants and cross-country health care. Moreover, the healthcare professionals have not limited to work within their healthcare institution, and they can join the telehealth platform as overtime freelance to earn additional income globally.

The new business opportunity is extended to patient identification, eligibility verification, and secure electronic health record-keeping services. The health and medical records on the telehealth platform, including medical records from all participants, is a crucial element that needs a secure environment to manage and control by using blockchain [19].

Wearable technology and the internet of things (IoT) are growing exponentially. Advanced features on wearable devices and IoT devices for healthcare directly assist the telemonitoring

system on the telehealth platform [20]. The innovation of biosensors combines with the internet of thing technology can transmit health information to the telehealth platform in many ways. Some biosensors devices can also implant inside a human body. These valuable technologies enable remote monitoring of patients, including disease prevention and early disease detection. Health professionals that join the telehealth platform can monitor the patient remotely and promptly alert when the critical condition is reached or early onset of an illness. The telemonitor is an essential part of the telehealth services both in remote monitoring patient conditions and worth for data analytics, diagnostic prediction and insightful for the critical alert pattern [21], [22].

The artificial intelligence (AI) health service is another telehealth service that can plug into the platform. AI is the norm for a primary assistant on the telehealth platform. The AI assistant can start from an AI chatbot to ask for the patient's symptoms before making the online appointment or triage illness to direct the patient to the appropriate physician. Advanced AI is possibly substituting physician diagnostics. For example, Ping An Good Doctor is a Chinese startup company providing an AI-supported one-stop healthcare ecosystem platform in China. The solution enables patients to get medical advice, first by a triage with an AI-supported bot that collects their medical history and provides preliminary diagnostic suggestions [23].

Digital health engagements motivate patients to achieve and maintain healthy lifestyle habits and prolong patients' life. The health engagements encourage the patient to get involved with the platform by offer rewards, activities, competition or benefits. In addition, a patient may request personalized health coaching based on AI automated coach for lifestyle navigators. The combination of healthcare information from past medical records on the platform, health tracking from wearable devices, vital signals from IoT devices, and digital health engagement can produce health risk quantification as a health score [24].

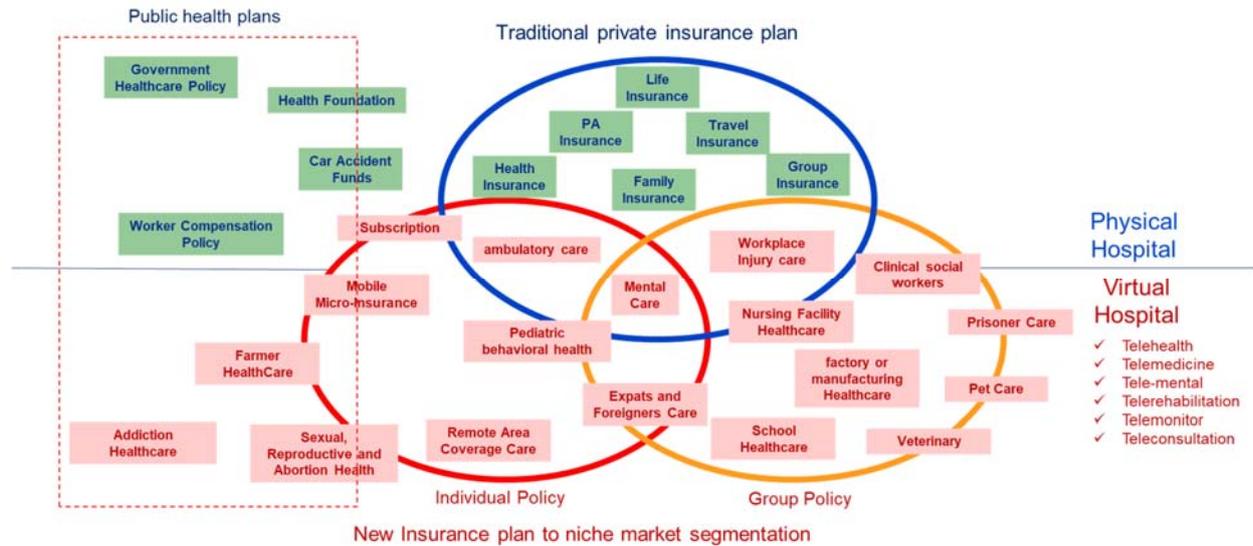


Fig. 4 Summary of traditional insurance products and new insurance products with market segmentation

The health score of the patient is a valuable outcome to other businesses. Several business sectors could use the health score to qualify customer engagement. Health score enables insurers and health institutions to analyze their member's health risks, including automatic pricing engines, accelerated underwriting, and optimized care management. Health score offers patients insight about their health for healthcare providers and partners to match products and services for individual needs. The health score is also valuable for the financial business sector in determining the ability to pay off the loan based on the borrower's health behavior and lifestyle.

The most valuable business opportunity is accumulating healthcare information from electronic health records and telemonitoring systems, which can be utilized to create new business models from the analysis of the health data. The advantages are to analyze disease and treatment for medical research, find the patient insights for healthcare marketing, and identify needs for financial services. Moreover, a patient's health risk score can be processed from patient health data. The health risk score is the most valuable for an insurance carrier in underwriting methods [24].

Another potential opportunity is the marketing campaign for individual personalized care. For example, the telehealth platform can offer digital health marketing to healthcare providers or related health businesses to promote their products or services. The telehealth platform realized the patient insight and can predict patient preference to match the marketing campaign automatically.

Telehealth can offer real-time watching for patient activities and integrate with social media platforms to understand patients' needs. Telehealth finds an appropriate time frame to reflect patient emotions to offer health products, care services, treatments, or financial assistance.

In conclusion, telehealth service changes the healthcare ecosystem into a new paradigm with numerous digital healthcare business elements. Thus, the telehealth platform becomes the core digital business model for integrating all

health services into one telehealth application to serve the patient better.

#### IV. CHALLENGES AND OPPORTUNITIES

Telehealth represents an opportunity to redesign the way health care is delivered. The telehealth system reduces patient's healthcare costs compared with traditional service models. With telehealth solutions, healthcare providers collaboration presents optimized resource distribution among the healthcare institution, non-contact treatment and independent healthcare professionals, which realize the value of physicians through multiple channels.

The challenges and opportunities of healthcare insurance carriers are to reshape their products to match the new market segmentation of telehealth, which extends the digital coverage and reimbursement for digital healthcare services. An insurer can preserve the claim reimbursement with a telehealth platform because remote diagnostic can divert patients from emergency departments to appropriate healthcare services, saving costs significantly. Consequently, innovative insurance product design with digital health services coverage can reduce the insurance premium to the affordable market segment, meagre income in a remote area. Innovative insurance products that serve a niche market segmentation are challenged health insurance carriers to promote telehealth platforms. In addition, some telehealth platforms offer monthly subscription fees as substitution services. The niche market segment matches digital healthcare services, including addiction healthcare, sexual and reproductive healthcare, abortion healthcare, pediatric behavioral health, and mental health. In addition, the insurer can offer a brand-new health coverage plan for ex-pat professionals to ensure that insurance is covered while working overseas or extend the digital care service with existing travel insurance. The telehealth platform can expand its services across the boundary of a country which can provide healthcare professionals with the mother-tongue language speaker to serve

foreigners. Fig. 4 summarized the traditional and new insurance products with various market segmentation in both individual and group policy, including the national health plan for supporting specific patient populations.

Workplace injury care is another domain so that telehealth can serve employers better than traditional healthcare services. For example, a blue-collar worker in a factory, manufacturing, or construction site requires urgent care in case of injury and sickness, which is telemedicine can provide better services in terms of faster care advisory. In addition, the group insurance can add rider coverage for telehealth services to aids schools care, prisoner care, and nursing home care, which can reduce dedicated physicians in their healthcare facility.

A trendy opportunity for a new business model is telehealth for pet care. The pet care market is segmented into a channel that includes veterinary clinics, pet shops and other pet services. Pet health problems and sickness can adopt the use of telehealth solutions. The pet teleconsultation service is another popular area for pet owner which include pet behavior and training.

Insurance technology (InsurTech) is a technology startup company that takes advantage of the consumer trends that use smartphones regularly and expect the convenience of these digital technologies. InsurTech offers typically selling an insurance product online, which including the telehealth service for their consumer. InsurTech platform is a bundle of several digital healthcare services to gain an advantage over traditional insurance products. For example, an insurance policy allows customers to use telemedicine as a front-end service for an online health consultation. Another example is using a telemonitor and a wearable device of the customer to measure good health behavior to reduce the insurance premium regularly.

The challenge in the new market of telehealth solutions is not limited to insurance companies. The active employer is taking a role as self-insurer for health service to their employee. Therefore, a large enterprise can offer digital healthcare services through a telehealth platform to their employees to reduce insurance premiums. For example, Amazon is rolling out its telehealth service Amazon Care to its employees across all 50 states of the US and has made plans to expand the virtual care program to other employers later. In addition, Amazon launched pharmacy e-commerce for their existing customer [25].

The technology companies that provide telehealth solutions also offer a subscription-based service for their customers with low cost and unlimited telehealth access. In addition, the coverage can be tailored to healthcare solutions per individual demands. Micro telehealth insurance is a plan for short-term small health events or minimal ongoing health subscription programs—for example, a micro-subscription for a specific illness for one month.

The health assessment service is a significant challenge, like a credit bureau that provides personal financial risk as a credit score to the financial institution and other related businesses to evaluate financial loans. As a result, the health assessment service offers a health risk score for insurance carriers for government health sectors and private insurance to

underwriting the coverage and premium of the individual health plan. The service also covers a high-risk patient prevention model, which concentrates on insuring and managing potentially costly patient groups.

Health scores create a business value chain to other related industries, not only the healthcare and insurance industry but also the financial business sector and the marketing business sector. For example, in long-term financial services (e.g., mortgage loan), the financial institution may require a health score to validate the instalment term. Likewise, the insurer may need a health score to underwriting the life policy premium for life insurance products. The marketer may need a health score for healthcare products and supplementary food products to promote their product to the consumer.

However, there are many challenges in the telehealth business model. Healthcare providers are fragmented in care services with the independent system, including the bureaucracy workflow process, which is challenging to transform into a streamlined digital process. To reform the existing healthcare organization into digital services is more complicated than starting a new business with telehealth solutions. Another barrier is the regulation restriction of a physician to work across the countries and multidisciplinary of healthcare service among healthcare providers. The insurance provider may limit the healthcare coverage, especially those operating in multiple countries, to design benefits that meet the consumers' needs.

## V. CONCLUSION

Patients can benefit from increased convenience and access to health care services through telehealth solutions. Remote patient monitoring can also help to reduce the cost of health insurance carriers with chronic conditions. The new business model expands the use of telehealth services to provide better access to care for people living in underserved areas. Leverage telehealth to target services for underserved communities ensures convenient access to high quality, affordable care. As a result, patient population groups may be more comfortable using telehealth to receive benefits. In addition, telehealth can extend the reach of care teams, allow for real-time monitoring, increase data collection to guide an individual's treatment, and provide prompt response to crises during treatment.

There is enormous opportunity in the telehealth expansion business model. The paper has summarized the challenges and opportunities for newcomer investors looking to invest in the digital business model for the healthcare industry.

The new business opportunity includes:

- 1) Extending digital healthcare services from healthcare providers.
- 2) Enhancing digital health services from the existing plan of health insurance carriers.
- 3) Introducing a new insurance product for different market segmentation.
- 4) Launching telehealth subscription model for covering under market segmentation.
- 5) Opening the health assessment service to determine the patient health condition to both insurance and financial

industry.

6) Promoting personalized care and patient insight for a marketing campaign.

The additional benefit from the telehealth solution is the integration of healthcare services among the participant in the telehealth ecosystem into one telehealth application for the convenience of a patient. Medical and health records of a patient are put into one place for sharing and efficiently managing.

The growth of the digital business is not limited to the e-commerce marketplace, financial matching platform and ride-hailing business. In the future, most healthcare services will turn into digital services that can serve patients at their accommodation wherever they live. Therefore, a patient will visit a hospital as necessary for severe illness only.

REFERENCES

[1] McKinsey, Telehealth: A quarter-trillion-dollar post-COVID-19 reality? July 9, 2021 (access Aug, 2021) <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality>

[2] Han Y, Lie R, Guo R, The Internet Hospital as a Telehealth Model in China: Systematic Search and Content Analysis, J Med Internet Res 2020;22(7):e17995 URL: <https://www.jmir.org/2020/7/e17995> DOI: 10.2196/17995

[3] Health Analytics Asia, How China used telemedicine to fight COVID-19, (access May 2021) <https://www.ha-asia.com/how-china-used-telemedicine-to-fight-covid-19/>

[4] Christopher, Cheney, Cost saving for telemedicine estimated at \$19 to \$120 per patient visit, May 2019 (access Aug 2021) <https://www.healthleadersmedia.com/clinical-care/cost-savings-telemedicine-estimated-19-120-patient-visit>

[5] James Galloway, et al, The impact of disease severity and duration on cost, early retirement and ability to work in rheumatoid arthritis in Europe: an economic modelling study, Rheumatology Advances in Practice, Volume 4, Issue 2, 2020, <https://doi.org/10.1093/rap/rkaa041>

[6] CBInsights, Research Report, State of Healthcare Q3'20 Report: Sector And Investment Trends To Watch. (access October 2020) <https://www.cbinsights.com/research/report/healthcare-trends-q3-2020/>

[7] Mahtta, D., Daher, M., Lee, M.T. et al. Promise and Perils of Telehealth in the Current Era. Curr Cardiol Rep 23, 115 (2021). <https://doi.org/10.1007/s11886-021-01544-w>

[8] Herman B. VIRTUAL REALITY: More insurers are embracing telehealth. Modern Healthcare. 2016;46(8):0016. Accessed August 14, 2021.

[9] Faggini M, Cosimato S, Nota FD, Nota G. Pursuing Sustainability for Healthcare through Digital Platforms. Sustainability. 2019; 11(1):165. <https://doi.org/10.3390/su11010165>

[10] "Vital Healthcare Capital Launches \$30 Million Social Impact Loan Fund Supporting Better Care for People with Complex Needs in Low-Income Communities." *Mental Health Weekly Digest*, 30 Nov. 2015, p. 200. <https://business.amwell.com/> (access Aug 2021)

[11] <https://www.teladochealth.com/> (access Aug 2021)

[12] <https://ro.co/> (access Aug 2021)

[13] <https://www.guahao.com/> (access Aug 2021)

[14] <https://www.haodf.com/> (access Aug 2021)

[15] David Ian Barrett, & Nayanabhiram Kalnad. (2014). Deployment of digital healthcare kiosks in the workplace: Utilisation and acceptability. *International Journal of Integrated Care*, 14(8), International journal of integrated care, 01 November 2014, Vol.14(8).

[16] Kountze, M., & Lunsford, R. (2019). HealthSpot's Pursuit to Provide Global Healthcare Access Through Telemedicine. *Journal of the International Society for Telemedicine and EHealth*, 7, e19 (1-7). <https://doi.org/10.29086/JISfTeH.7.e19>

[17] United Nations, World Population Ageing 2019 Highlights, <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf>

[18] Niu, S., Chen, L., Wang, J., & Yu, F. (2020). Electronic Health Record Sharing Scheme With Searchable Attribute-Based Encryption on Blockchain. *IEEE Access*, 8, 7195-7204.

[19] S. Ravali and R. Lakshmi Priya, "Design and Implementation of Smart Hospital using IoT," 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), 2021, pp. 460-465, doi: 10.1109/ICCMC51019.2021.9418296.

[20] Shola Usharani, Antony Ignatious, Bhava Hari and V. Balavishnu, "IoT Patient Health Monitoring System", *Indian Journal of Public Health Research & Development*, vol. 8, pp. 1329, 2017.

[21] Wang, P., & Kricka, L. (2018). Current and Emerging Trends in Point-of-Care Technology and Strategies for Clinical Validation and Implementation. *Clinical Chemistry*, 64(10), 1439-1452.

[22] Wiseschinda, Varut. (2020). Deep Medicine How Artificial Intelligence Can Make Healthcare Human Again. *The Bangkok Medical Journal*; Vol. 16 No. 2 (2020): September; 250.

[23] Dacadoo.com, Health Risk Quantification and Health score, (access Aug 2021) <https://www.dacadoo.com/products-services/dacadoo-health-risk-quantification/>

[24] Bertha Coombs, Amazon is expanding Amazon Care telehealth service nationally for its employees and other companies, *CNBC Health and Science*, Mar 17, 2021 (access Aug 17, 2021) <https://www.cnbc.com/2021/03/17/amazon-is-expanding-amazon-care-telehealth-service-nationally-for-employees.html>



**Rattakorn Poonsuph** is an expert in software architecture, software engineering, blockchain, FinTech, InsurTech, HealthTech, cryptocurrency and digital marketing. Experience working in researching and consulting for 30 years both domestically and internationally for government and private organizations.